ANNUAL REPORT 2015

unam

National Nanotechnology Research Center

Institute of Materials Science and Nanotechnology

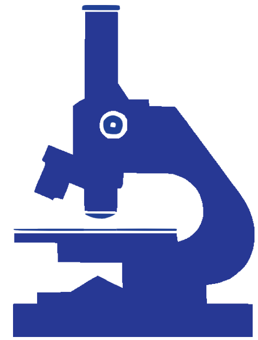
unam is supported by the Ministry of Development of Turkey and managed by Bilkent University

CONTENT

UNAM WITH NUMBERS

9200 m^2 total laboratory space

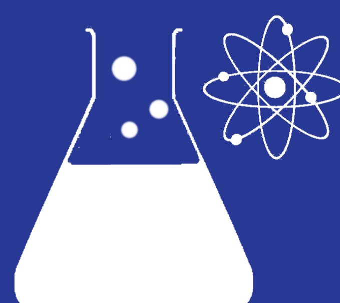
$35 million investment



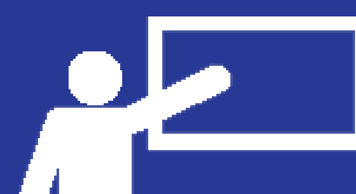
70
laboratories

As a national nanotechnology center, UNAM is continuously growing and reaching out to more researchers every year. This steady growth reflects itself in the scientific and technological outcome of our center. UNAM's everyday users is exceeding 400, while there are more than 800 users in total. As the number of researchers and projects is increasing, UNAM is becoming a hub for nanotechnology research.

over $125 million
research budget



71
active projects



18
workshops organized and hosted

376 researchers

35 faculty members
33 scientists
33 post-docs
236 graduate students
25 engineers and technicians
14 staff

over 800 users

> 400 external users
> 400 internal users
> 25 Companies
> 85 Universities

over 700

high impact journal articles in the last 5 years

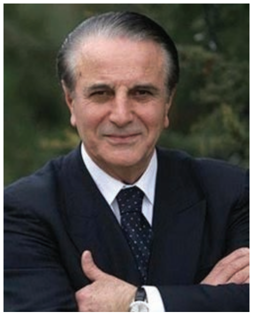
16
spin-off companies

30
patents

61
awards

110
alumni

VIEWS ABOUT UNAM



The "optimal of Turkey" requires the improvement of very comprehensive and multi dimensional strategies in science, culture, education, technologies, economy, political will, ethics, value systems e.g. The nanoscience and nanotechnology contribution will be to move to the upper strata, the socio-economic trends as a very important subset and be a catalyst in the system by providing multifactorial, multisectorial productivity and value added increase.

"National Nanotechnology Research Center – UNAM" takes place on the upper strata of this search in converging to the "Optimal of Turkey" and to the highest international science targets. As a citizen, scholar I would like express my deep esteem and gratitude to the Founding Director Salim Çıracı, to all those who contributed and are contributing to the achievements of this remarkable research center.

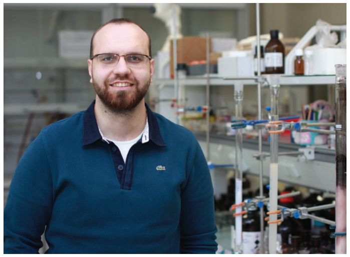
Prof. Dr. Orhan Güvenen,
Bilkent University
Executive Committee Member and the Chairman of the Advisory Board on Strategy,
Economy and Industry of National Nanotechnology Research Center (UNAM)

It wouldn't be an exaggeration to say that I lived and worked in UNAM for 7 years. My life was so overwhelmed by research and focused entirely on catching up with other high reputation institutions all around the world. When I came to MIT, I realized that people working here have been actually following my studies and trying to obtain the same results. In my first presentation here, people were writing down the process parameters, asking detailed questions, and trying to capture slides for their benefit. That of course doesn't prove that Bilkent University or UNAM is superior to MIT, but it definitely proves that we can be on their level if we work hard and constantly question the scientific literature.

Dr. Mehmet Kanık, MSN'15

During my PhD studies under the supervision of Prof. Salim Çıracı, I had the chance to benefit from the world-class research environment that UNAM provides to its graduate students. I believe that the diversity of research fields and friendly environment between professors and students always keep UNAM members highly motivated in their research and provide them with lots of research options and ideas. This enables students to get involved in research projects of their interest, publish in top journals, present their results at international conferences, make connections and get known in their field during their PhD years. I feel lucky for being a member of this community

Dr. Veli Ongun Özçelik, MSN'15



Dr. Akkaya’s research group at UNAM offered me the latest in technological and equipment infrastructure, providing us with the means to test all our ideas and greatly increasing the quality of our work. Collaborations that we carried out with other research groups at UNAM have also helped my ability to see the problems from different perspectives.

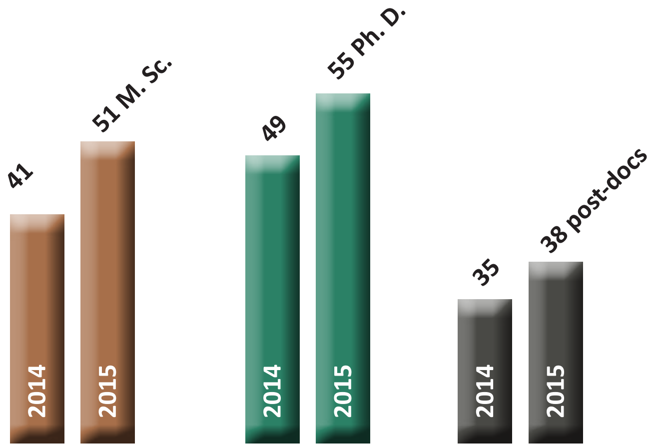
Dr. Safacan Kölemen, MSN’14

During my Ph.D., under supervision of Prof. Bayindir, I found the opportunity to conduct state-of-the art and highly interdisciplinary research combining microphotonics, microfabrication, nanotechnology, surface chemistry, and molecular biology. The results of our studies were published in some of the most prestigious scientific journals. I cordiallyendorse that UNAM is the best place in Turkey for pursuing a graduate career related to science and engineering

Dr. Erol Özgür, MSN’14

EDUCATION

Education activities at UNAM are organized through our Material Science and Nanotechnology (MSN) program. We are currently offering Master of Science (M.S.) and Philosophy of Doctorate (Ph.D.) degrees under MSN program. As of 2014, MSN program has 51 M.Sc. students, 55 Ph.D. students and 33 post-docs. We accept students from a wide variety of backgrounds. Amongst over 100 graduate students, there are students from nearly all engineering fields (31%) and fundamental sciences (69%). Currently, we have students/post-docs from 13 different countries. UNAM is the choice of researchers who are seeking a multidisciplinary and multinational environment.



Reflecting the multidisciplinary nature of UNAM, MSN curriculum has a wide variety of courses from physical sciences, chemical sciences and life sciences as well as engineering sciences. Multi-disciplinary MSN program is designed to encourage the students to gain expertise in a broader view towards developing ideas at the interface of physical/chemical, life sciences as well as engineering. The program provides the students an opportunity to work across disciplines and to develop a common language between different scientific backgrounds. This enhances the students' ability towards problem solving and generation of novel ideas. An important aspect of our diverse education is to foster the ground for interaction of students at different levels and to encourage team work.

Course Code	Course Name
MSN 500	Concepts in Materials Science
MSN 501	Atomic Structure, Mechanical and Thermal Properties of Materials
MSN 502	Nanoscale Materials and Nanotechnology
MSN 503	Quantum Mechanics for Materials Science I
MSN 504	Phase Transformations and Diffusion in Materials
MSN 505	Fundamentals of Thin Film Materials
MSN 506	Experimental Methods in Applied Physics
MSN 507	Electrical, Optical and Magnetic Properties of Materials
MSN 508	Quantum Mechanics for Materials Science II
MSN 509	Statistical Thermodynamics
MSN 510	Imaging Techniques in Materials Science and Nanotechnology
MSN 511	Surface Science and Spectroscopy
MSN 512	Biomedical Materials
MSN 513	Micro and Nanostructured Sensors
MSN 515	Nanotechnology in Agriculture and Food
MSN 517	Fundamentals of Nanoscience
MSN 518	Fundamentals of Nanotechnology
MSN 519	Applications of Microfluidics and Nanofluidics
MSN 520	Materials and Technologies for Radio Frequency and Terahertz Devices
MSN 521	Biotechnology
MSN 522	Moleculer Biomimicry and Synthetic Biology
MSN 532	Selected Topics in Materials Science and Nanotechnology
MSN 533	Nanomaterieals for Energy Conversation and Storage
MSN 534	Polymeric Materials
MSN 535	Textile Materials
MSN 541	Nanobiotechnology
MSN 543	Protein and Gene Engineering
MSN 551	Introduction to Micro and Nanofabrication
MSN 555	Nanomaterials Processing by Intense Laser Beam
MSN 590	Seminars in Materials Sci. & Nanotechnology: Technology Development
MSN 591	Nanotechnology and Its Impacts on Socio-Economic Structures
MSN 598	Seminar I
MSN 599	Master's Thesis
MSN 601	Advanced Computational Nanoscience
MSN 698	Seminar II
MSN 699	Ph.D. Thesis

UNAM ALUMNI

UNAM graduates continue their careers at world's leading universities or start industrial careers at high tech companies. Below is the list of UNAM alumni and their current positions. Thanks to the world class education provided at UNAM, our alumni are well sought after in academia and industry.

Name	Current Institute	Current Position
Yusuf Çakmak	Manchester University	Post-doctoral Associate
Sündüs Erbaş Çakmak	Manchester University	Post-doctoral Associate
Hasan Şahin	University of Antwerp	Post-doctoral Associate
Hülya Budunoğlu	Aselsan	Project Engineer
Oya Ustahüseyin	Max Planck Institute	Ph.D. Student
Pınar Angün	Eti	Project Engineer
Sıla Toksöz	Boston University	Ph. D. Student
Tural Khudiyev	MIT	Post-doctoral Associate
Erol Özgür	Bilkent University	Post-doctoral Associate
Bülent Öktem	Aselsan	Project Engineer
Kemal Gürel	Garanti Bank	Business Analyst
Murat C. Kılınç	Aselsan	Senior Engineer
Gökçe Küçükayan Doğu	Intel Corporation	Process Engineer
Özlem Şenlik	Duke University	Ph.D. Student
Yasemin Coşkun	Arçelik	Project Engineer
Kıvanç Özgören	FibLas Fiber Lazer	Manager
Handan Acar	University of Chicago	Post-doctoral Researcher
Seymur Cahangirov	Universidad Del Pais Vasco	Post-doctoral Researcher
Mehmet Topsakal	University of Minnesota	Post-doctoral Associate
Hüseyin Duman	Roketsan	Project Engineer
Mert Vural	Carnegie Mellon University	Ph.D. Student
Aslı Çelebioğlu	Bilkent University	Post-doctoral Associate
Hepi Hari Susapto	Abdullah King University	Ph.D. Student
İnci Dönmez	METU-MEMS	Researcher

Urangelder Tursindovj	University of Bonn	Ph.D. Student
Yavuz Nuri Ertaş	UCLA	Ph.D. Student
Salamat Burzhuev	University of Waterloo	Ph.D. Student
Serkan Karayalçın	Ministry of Health	Specialist
Çağla Özgit Akgün	Aselsan / IBM	Project Engineer
Rashad Mammadov	University of Virginia	Post-doctoral Associate
Tuğba Özdemir Kütük	Bilkent University	Post-doctoral Associate
Safacan Kölemen	UC Berkeley	Post-doctoral Associate
Hilal Ünal Gülsüner	University of Washington	Post-doctoral Researcher
Onur Büyükçakır	KAIST	Post-doctoral Researcher
Yazgan Tuna	Max Planck Institute	Ph.D. Student
Hakan Ceylan	Max Planck Institute	Post-doctoral Associate
İmmihan Ceren Garip	Max Planck Institute	Ph.D. Student
Zahide Didem Mumcuoğlu	FUJIFILM Europe B.V.	Researcher
Diren Han	Ülker Hero Baby	Engineer
Melis Göktaş	Max Planck Institute	Ph.D. Student
Andi Çupallari	City University of New York	Ph.D. Student
Ali Ekrem Deniz	Linde Industrial Gases	Specialist
Fatma Kayacı	TÜBİTAK-SAGE	Specialist
Adem Yıldırım	University of Colorado	Post-doctoral Researcher
Ruslan Garifullin	Bilkent University	Post-doctoral Researcher
Mehmet Kanık	MIT	Post-doctoral Asscociate
Mehmet Alican Noyan	ICFO-The Institute of Photonic Sciences	Ph.D. Student
Deniz Kocaay	Inter University Microelectronics Centre	Ph.D. Student

INFRASTRUCTURE

UNAM building has been designed to be a multidisciplinary research environment for researchers from various disciplines. Since the establishment of UNAM, the infrastructure has been developed to satisfy the needs of researchers from universities and institutions in Turkey and neighboring countries. With its ever expanding capabilities, UNAM is providing the 21st century state-of-the-art technology to support the research and development activities. As equally importantly, the specialized instruments can be utilized with the guidance of highly qualified technical personnel. The novice users are accompanied by experienced UNAM personnel in order to make the most of the time they spend at UNAM facility.

UNAM infrastructure is maintained regularly to satisfy the need of researchers. A list of the available instruments are given in this section. The details of each instrument can be viewed on our facility webpage. UNAM information system, UNAM-IS, is a one stop address to have access to these equipment. The users first sign up to receive their username and password. After defining their project, they can access to all the listed equipment. The reservation procedure is hassle-free. The users can monitor the availability of the equipment and reserve it from the UNAM-IS portal.

Imaging / Microscopy

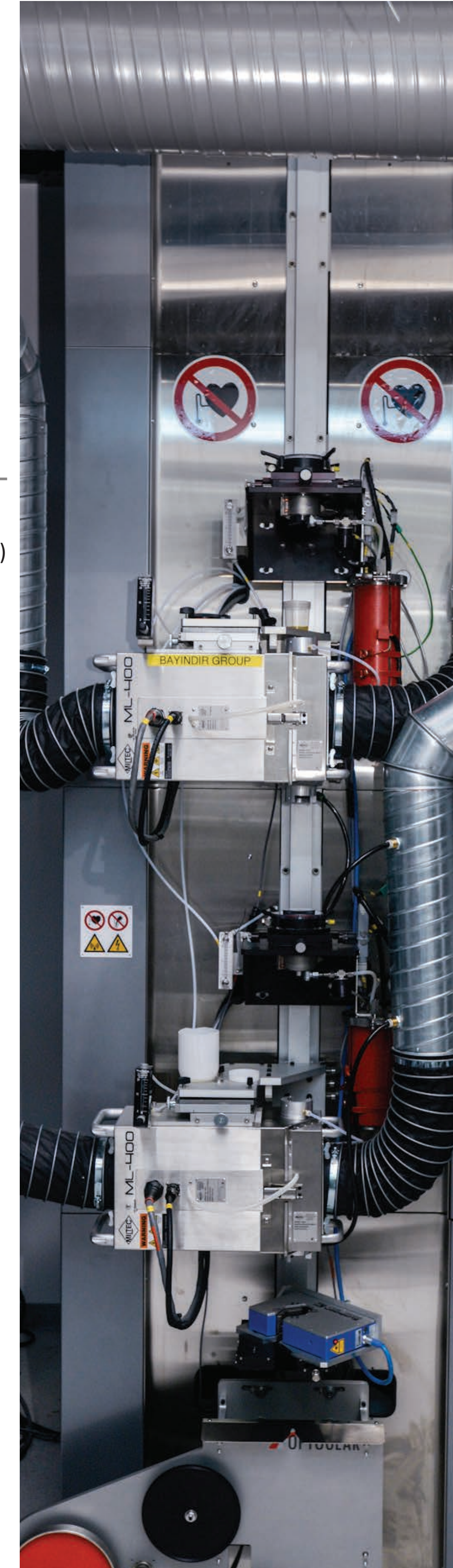
Atomic Force Microscope (AFM, PSIA)
Atomic Force Microscope (AFM, Asylum)
Confocal Microscope
Dual Beam
E-Beam Lithography (E-BEAM)
Environmental Scanning Electron Microscope (ESEM)
Fluorescent and DIC Equipped Upright Microscope
Fluorescent and DIC Equipped Inverted Microscope
Material Microscopes
SNOM + Raman Microscope
Stereomicroscope
Transmission Electron Microscope (TEM)

Spectroscopy / Chromatography

Accurate-Mass Quadrupole Time-of-Flight (Q-TOF) LC/MS
CHNS/O Elemental Analyzer
Circular Dichroism System (CD)
Fluorescence Spectrophotometer
Fluorospectrometer
FTIR Spectrometer (Tensor 37)
FTIR Spectrometer with Microscope (Nicolet 6700)
FTIR Spectrometer with Microscope (Vertex 70)
FT-Raman Spectrometer
Gas Chromatography Mass Spectrometer (GC/MS)
Gel Permeation Chromatography (GPC)
High Resolution Mass Time-of-Flight (TOF) LC/MS
Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)
Microplate Reader
Nuclear Magnetic Resonance Spectrometer (NMR)
Preparative High Performance Liquid Chromatography
Size Exclusion Chromatography (SEC)
Time-resolved Fluorescence
UV-VIS Spectrophotometer
UV-VIS-NIR Spectrophotometer
X-Ray Fluorescence Spectrometer (XRF)
X-Ray Photoelectron Spectrometer (XPS)

Optical / Lasers

Carbondioxide Lasers (Coherent, Lumenis)
Ellipsometer (IR-VASE)
Ellipsometer (V-VASE)
Femtosecond Laser System
Fiber Laser (Toptica)
Fiber Polishing Machine
FSP Spectrum Analyzer
He-Cd Laser (Kimmon)
He-Ne Lasers
High Power Lasers (custom)
High Precision Positioning System
Infrared Camera
Lock-In Amplifiers
Monochromators
Optical Spectrum Analyzers
Solar Simulator
Supercontinuum Laser Source
Tunable Diode Laser (Toptica)
Tunable Semiconductor Laser (Santec)
Tunable Telecommunication Laser (Newport)
UV Lasers
Xe, Halogen, Deuterium Light Sources



Material synthesis / Characterization

BET Physisorption-Chemisorption
Contact Angle Measurement System
Differential Scanning Calorimetry (DSC, Netszch)
Differential Scanning Calorimetry (DSC, TA)
Dynamic Mechanical Analyzer
Freeze Dryer System
Glovebox
Isotermal Titration Calorimetry (ITC)
Materials Research Diffractometer (MRD)
Micromechanical Tester
Multi-Purpose X-Ray Diffractometer
Porosimeter
Physical Property Measurement System (PPMS)
Pycnometer
Rheometer
Single-Crystal X-Ray Diffractometer
Thermal Gravimetric Analysis (TGA)
Zeta Potential (Zeta Sizer)

Cleanroom

Asher
Atomic Layer Deposition (ALD, Fiji)
Atomic Layer Deposition (ALD, Savannah)
Autoclave
Critical Point Dryer
Dicing Saw
Die Bonder
E-Beam Evaporation
Electroplating Station
Hot Plates
Inductively Coupled Plasma (GaN, GaAs)
Inductively Coupled Plasma (Si)
Low Pressure Chemical Vapor Deposition (LPCVD)
Mask Aligner
Mask Aligner with Nanoimprint Lithography
Mask Writer
Optical Profilometer
Organic Thin Film Evaporator
Plasma Enhanced Chemical Vapor Deposition (PECVD, Plasma-Therm)
Plasma Enhanced Chemical Vapor Deposition (PECVD, Vaksis)
Probe Station
Rapid Thermal Annealing (RTA)
Scanning Electron Microscope (NanoSEM)
Semiconductor Parameter Analyzer
Spinners
Sputtering Systems
Stylus Profilometer
Thermal Evaporators
Wet Benches
Wire Bonders
XeF_2 Etcher

Biotechnology

Bioreactors (2 lt / 5 lt / 30 lt)
Centrigures / Microfuges / Ultracentrifuges
Cold Room
Cryostat
Electroporator
-80 Freezers
Gel Imaging and Documentation System
Gradient PCR
Gradient Real-Time PCR
Laminar Flow Cabinets
Microplate Reader
Microtomes
Osmometer
Shaking Incubators
Sterile Cabins
Vibratome

Fiber production / Characterization

Fiber Draw Tower
Fiber Draw Tower (High temperature up to 2300 ^{o}C)
Glass Production System
Infrared Camera
Modified Chemical Vapor Deposition (MCVD)
Preform Analyzer
Preform Consolidator
Preform Polariscope
Preform Slice Measurement System
Preform Washer
Quartz Cutting Saw
Rocking Furnace
Scrubber
Thermal Evaporation System
Three-zone Furnace (1200 ^{o}C)
Vacuum Ovens

Sample preparation

Cut-off and Grinding Machine
Dimple Grinder
Disc Grinder
Disc Punch
Electrolytical Thinner
Glass KnifeMaker
Grinding and Polishing Machines
Mounting Press
Precision Etching Coating System (PECS)
Precision Ion Polishing System (PIPS)
Ultramicrotome
Ultrasonic Cutter
Vacuum Impregnation

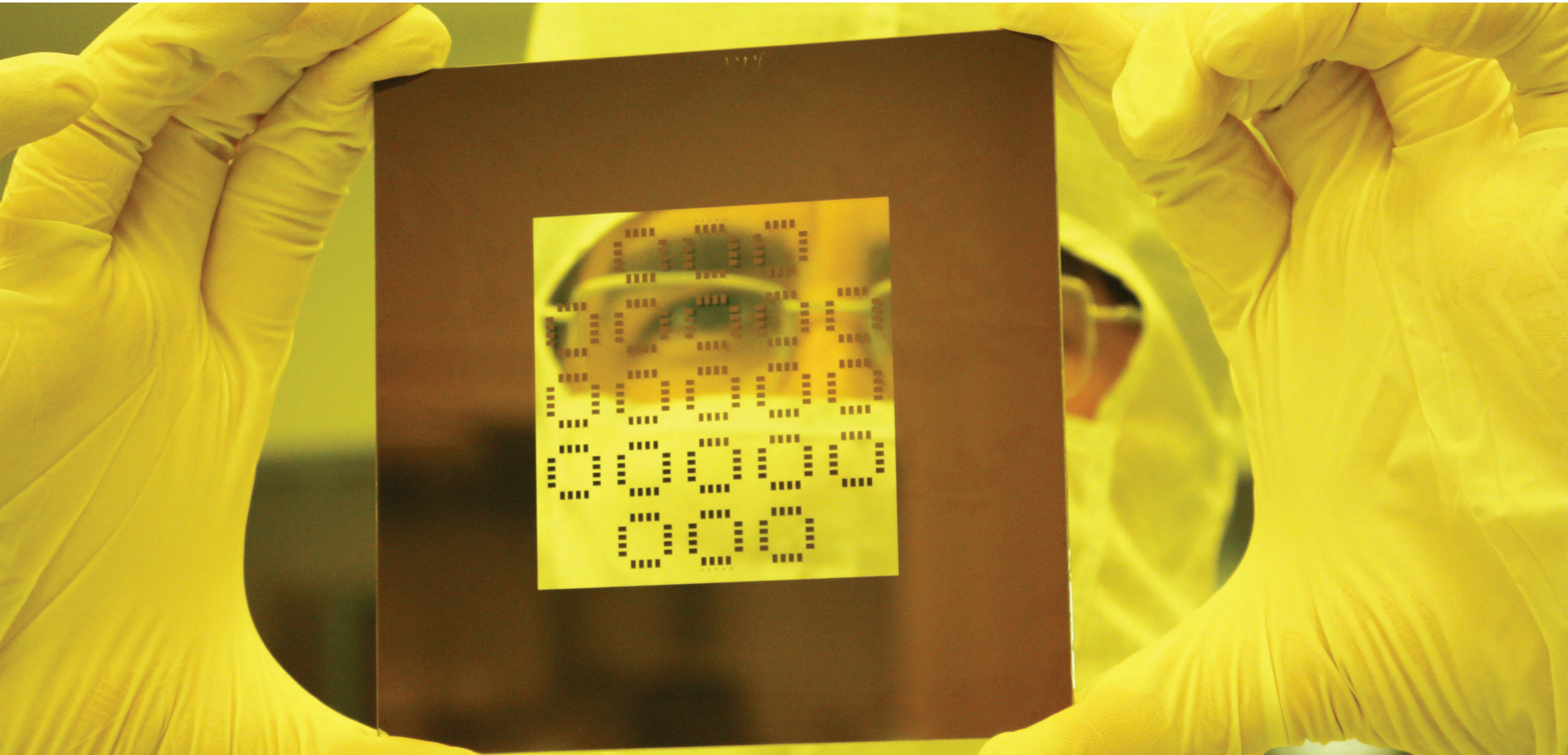
CONTRIBUTIONS TO INDUSTRY AND ACADEMIA


nature
484, 411–558

PARTNERSHIP WITH INDUSTRY

UNAM fosters an environment promoting industry and academia partnership. Researchers at UNAM have a strong ability to manage interdisciplinary projects and also meet the expectations of industrial partners. UNAM aims to develop the scientific and technological capacity of SMEs and large organizations through joint projects and short term industrial contracts. Additionally, UNAM infrastructure enables the companies to have access to the state-of-the-art equipment and the know-how for their specific needs.

UNAM's 400 m² clean room comprises class 10, 100 and 1000 areas and is being further developed according to the needs of our researchers.
Currently, there are over 25 companies using the UNAM infrastructure on a regular basis. The total number of users from universities has reached over 800 in 2014. Since, UNAM is being used by several researchers of different interests, it provides researchers an excellent opportunity for networking as well. As the need for value added products in Turkey is increasing, UNAM will serve to more people with its technological capacity and know-how. In 2014, the number of users from industry was over 250. The feedback we received from these users is very encouraging and pushes us further in meeting the needs of all of our partners. In 2014, UNAM has also improved the training procedures for the first time users. The users are being served by a centralized contact point and can receive comprehensive hands-on tutorial and guidance from our dedicated personnel.



List of the companies utilizing UNAM infrastructure

Aselsan
Akzo Nobel Boya
Argetest
Ariteks Boya
Art Bant
As İnşaat
Bayrak Ar-Ge
Betopan
Biyotez Makina
Bosch-Siemens
Boylam Yazılım
Cyberpark
Deltamed Hacettepe
Dizayn Grup
Drogsan Eczacılık
Dyo Boya
E-A Teknoloji
Eczacıbaşı
Ermeksan
Eti Maden
Gata
Genamer Ar-Ge
Hemosoft
İksa Ltd.
Korozo
Maden Tetkik Arama
MAN
Mikron Makina
Milli İstihbarat Teşkilatı
Mono Kristal AR-GE
NanoDev
Nehir Biyoteknoloji
Norm Tıbbi Ürünler
Nurol Teknoloji
Okyay Enerji
Paşabahçe
PMS Medikal
Roketsan
Sanko Tekstil
Senses Biyoteknoloji
Sermed Tıbbi Cihazlar
So Soğutma
SPM Kompozit
Sun Tekstil
Şişecam
Tübitak Uzay
Tekser Limited Şirketi
Türkiye Petrolleri
Vamet Makine

UNAM SPIN-OFFs

As being the first nanotechnology research center of Turkey, UNAM is actively engaged in technologies that have high market value. The technological leaps discovered by UNAM researchers has been the seed for several UNAM spin-off companies. The companies benefit from the close proximity of incubation centers such as Bilkent Cyberpark, METU Technopolis and Hacettepe Technopolis which provide them the collaborative ecosystem to expedite the product realization cycle. In 2014, our spin-offs have benefited an additional boost with the establishment of Bilkent University Technology Transfer Office. A list of UNAM spin-off companies are given below.

- Synbiotik
- Auron Teknoloji
- Niser
- SY Nanoboya Teknoloji
- Nanodev
- IPS Ankara Tekno Bilişim Ar-Ge
- Biyonesil
- Deber
- E-A Teknoloji
- Nanosens
- Okyay Enerji
- Nanobiyoteknoloji

Nanodev Scientific

Nanodev Scientific is a spin-off company that manufactures advanced optical and biomedical characterization devices. Nanodev has revenue on wide range of high-tech products including Surface Plasmon Resonance Systems, Biomedical Detection Systems and Advanced Microscopes. Currently, Nanodev Scientific devices are being used at leading institutions worldwide. Novel projects of Nanodev were awarded several times, including "Most-Promising Start-up", "Novel Biomedical Device" and "1st prize in R&D Contest". Main goal of Nanodev is to apply cutting edge technology into daily life. The most promising project of Nanodev is a device that makes it possible to detect a series of diseases at home. Imagine being able to touch a small device and instantly get back whether you have key markers for a heart attack or an infectious disease. Such early detection tools are some of the innovative products that Nanodev is developing.

Nanodev booth at Materials Research Society Spring Meeting (MRS 2014)
San Fransico, CA, USA

E-A Teknoloji

E-A Teknoloji Ltd. is an UNAM spin-off company established in 2010. As of 2014, E-A Teknoloji enjoys its success in producing and marketing medical optical fibers for endovenous laser operations. Optical fibers have long been used in treatment of varicose veins, which were produced in European countries. After several years of R&D, an essential part of which took place at UNAM laboratories with close collaboration with Dr. Bülend Ortaç, now the know-how of medical optical fiber production for endovenous applications is accomplished. Among different types of optical fibers used in laser applications, especially radial emitters, of which output is in the shape of a homogenous ring towards the circumference of the fiber, are frequently used by the medical practitioners for their enhanced efficiency in the treatment. The radial fibers developed by E-A Teknoloji have passed all the tests necessary for the field use. Currently the serial production and marketing of these "Made in Turkey" radial fibers have been initiated, which is a huge leap for the company from doing solely R&D, towards large scale manufacturing. The very first feedbacks from the medical doctors that used these fibers were very motivating, indicating that they have better efficiency and durability compared to their available products in the market. Yet, the scope of the company is not limited neither to endovenous applications nor radial fibers, continuing research on other types of optical fibers, which would find applications in various fields such as urology, gynecology, ENT operations, ophthalmology and other minimally invasive and non-invasive laser applications.

illumination of the radial fiber
developed by E-A Teknoloji

UNAM USERS ALL ACROSS TURKEY

Are you after a challenging research problem? Do you need help in performing experimental measurements with state-of-the-art equipment? Then, UNAM is the place for you.

Since its establishment, UNAM has been serving hundreds of researchers from various disciplines. We believe sharing the expertise we have is the key to leapfrog revolutionary technologies. We place utmost priority in keeping the infrastructure functional for the use of all our users.

UNAM is accessible to all researchers. Currently there are more than 800 users of UNAM. Being located in Ankara, UNAM is accessible to all researchers across Turkey. In 2014, the number of universities who are utilizing UNAM has reached to 87. We receive very positive feedback from all UNAM users and this motivates us further in extending our facility and serving the whole community more effectively.

At UNAM, our users are fully engaged in all the steps of the service provided. It is not only the infrastructure, but also our expertise that help users make the most out of their experience at UNAM. We continuously strive to improve our technical capability and operation procedures to maximize the output of all UNAM users.

List of the universities utilizing UNAM infrastructure

Abdullah Gül University
Adnan Menderes University
Afyon Kocatepe University
Akdeniz University
Aksaray University
Amasya University
Anadolu University
Ankara University
Atatürk University
Atılım University
Balıkesir University
Başkent University
Beykent University
Bilecik University
Bilkent University
Bingöl University
Boğaziçi University
Bozok University
Çanakkale University
Celal Bayar University
Çukurova University
Cumhuriyet University
Dicle University
Dokuz Eylül University
Ege University
Erciyes University
Erzincan University
Erzurum University
Fatih University
Fırat University
Gazi Osman Paşa University
Gazi University
Gebze Technical University
Hacettepe University
Hatay University
Hitit University
İnönü University
İstanbul Technical University
İstanbul University
İzmir Katip Çelebi University
İzmir Institute of Technology
İzzet Baysal University
Kafkas University
Karabük University
Karadeniz Technical University
Karamanoğlu Mehmet Bey University
Kazım Karabekir University
Kırıkkale University
Koç University
Kocaeli University
Marmara University
Masdar Institute Abu Dhabi
Mehmet Akif Ersoy University
Melikşah University
Muğla University
Mustafa Kemal University
Musul University
Namık Kemal University
Nevşehir University
Niğde University
Ondokuz Mayıs University
Ordu University
Middle East Technical University
Osman Gazi University
Özyeğin University
Pamukkale University
Sabancı University
Sakarya University
Selçuk University
Süleyman Demirel University
Sütçü İmam University
University of Tehran, Iran
TED University
TOBB University of Economics & Technology
Trakya University
TÜBİTAK - Marmara Research Center
Turgut Özal University
University of Turkish Aeronautical Association
Antalya International University
Yazd University, Iran
Yeditepe University
Yıldırım Beyazıt University
Yıldız Technical University
Yüzüncü Yıl University
Zonguldak Bülent Ecevit University

TOTAL: 85 Universities

FEEDBACK FROM THE USERS

As a research group working on colloidal quantum dots at Abdullah Gul University; we have been using UV-VIS spectrophotometer, steady state and time resolved photoluminescence spectrometer, X-ray photoelectron spectroscopy, X ray diffractometer and transmission electron microscopy at UNAM. We are fully satisfied with the service we are getting from the central facility. The laboratory personnel and the professional management and support team all make it easy for us to access the facility at UNAM.

Assist. Prof. Dr. Evren Mutlıugün
Abdullah Gül University, Faculty of Engineering
Department of Electrical and Electronics Engineering

Plasma Aided Biomedical Research Group (pabmed) of TOBB ETÜ, University of Economics and Technology, is mainly active on developing “biosensors, bio-based nanofibers and surface modification of biomaterials”. Regarding to our scientific activities we have used the facilities of UNAM in recent period. The characterization of newly developed, tailor made surfaces of biomaterials, biosensors and electrospun nanofibers, by means of physical, chemical and physicochemical methods that were carried out in UNAM. We are quite happy and confident for the technical support of UNAM and their well-trained staff.

Professor Mehmet Mutlu
TOBB, ETU University of Economics and Technology
Faculty of Engineering, Biomedical Engineering Department

In 2015 we carried out our XPS and XRF analysis for our studies in UNAM. Both the infrastructure capability and the proficiency of the personnel helped us to collect high quality data. We have published out results in scientific journals and conferences. The ease of reaching to such a high-tech research facility helped us to get our data quickly. We are thankful for UNAM for their help and suggest everyone that they can choose UNAM as a trustworthy research center for their research needs.

Mustafa Burak COŞAR
Metallurgical and Materials Engineer
ASELSAN A.Ş

I think UNAM provides an excellent environment for research groups working in the field of materials science and nanotechnology. We, the TOBB-EU Nanomaterials Research Group, have been heavily and actively using environmental scanning electron microscopy, X-Ray photo electron spectroscopy, e-beam evaporator and atomic microscopy in last two years. It is very important that the students can observe and interact with highly experienced technical personnel during running their specimen characterization. Besides the state-of-the-art infrastructure I believe the technical support given for the analysis is very important, especially for ESEM we are using very frequently. We would like to thank UNAM for all their support and their solution oriented approach in case of any problems.

Assoc. Prof. Göknur Büke
Vice Chair
Department of Materials Science and Nanotechnology Engineering
TOBB University of Economics and Technology

I am using the FEI Nova NanoLab FIB-SEM platform for the “Micro and Mezo Scale Characterization of Porous Ceramic Electrodes by Electron Microscopy Techniques” project, which is currently being conducted in Sabancı University. I would like to express my gratitude for the service we received and further thank you for allowing the use of your laboratories by external users.

Dr. Meltem Sezen
Sabancı University
Nanotechnology Research Center

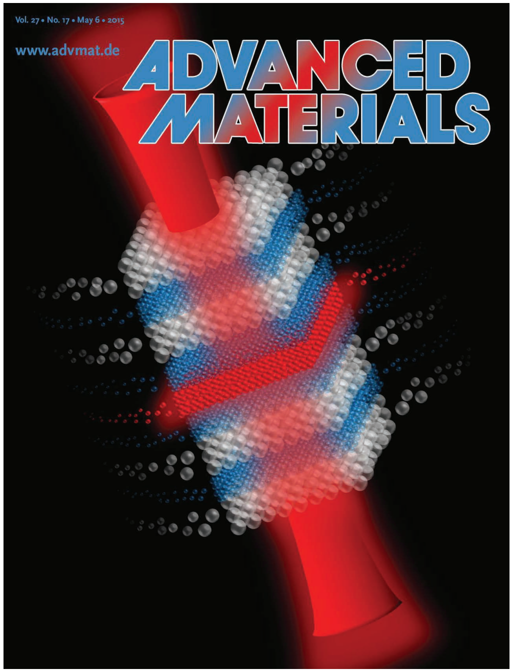
In last two years we have been using FTIR with Microscope in UNAM. We are very pleased with the service we are getting from UNAM. Technical staff has been very helpful and guided us throughout the whole process at every step from scheduling to using the equipment.

Ozan Ertürk
Middle East Technical University
MEMS Research Center

RESEARCH HIGHLIGHTS

UNAM has demonstrated striking achievements in terms of its scientific output despite its young age. UNAM researchers have published their findings at very high impact scientific journals such as Nature Materials, Nature Photonics, Nano Lettters, Angewante Chemie, Advanced Materials, ACS Nano, Lab on a Chip and Nanoscale.

An All-Colloidal Frequency Up-Converted Laser



UNAM researchers led by Prof. Hilmi Volkan Demir demonstrated an all-solution processed all-colloidal (AC) laser using tailored CdSe/CdS core/shell quantum dots, which exhibit highly stable and low-threshold optical gain owing to substantially suppressed non-radiative Auger recombination. Current semiconductor lasers face technological challenges to access the green and yellow regions of the spectrum. With quantum-confinement effects, colloidal quantum dots (QDs) are artificial atoms whose optical properties can be widely tuned via shape, size, and composition during a colloidal-synthesis process. QD-based optical gain media can be precisely controlled to make a laser at any wavelength in the entire visible spectrum, and further in the near-infrared region. Besides the advantages of color tunability and chemical processability, QDs promise temperature-insensitive optical gain because of well-separated energy levels and the atomic-like states. To date, optical gain has been shown with various colloidal core/shell QDs. However, the small volume of nanometer-sized QDs substantially increases the non-radiative multiexciton Auger recombination, creating a significantly large non-radiative channel for depleting exciton energy into heat. For the first time, the spatially and spectrally coherent, well-defined laser beam emission from an AC laser is presented especiallyat a record low threshold in frequency up-converted regime. These result would certainly extend to other sizes of QDs for different colors, representing a promising future for QD lasers as well as all-solution-processed lasers: the most cost-effective approach for single-material full-color lasers.
http://onlinelibrary.wiley.com/doi/10.1002/adma.201500418/full

Weighing and Imaging Molecules One at a Time

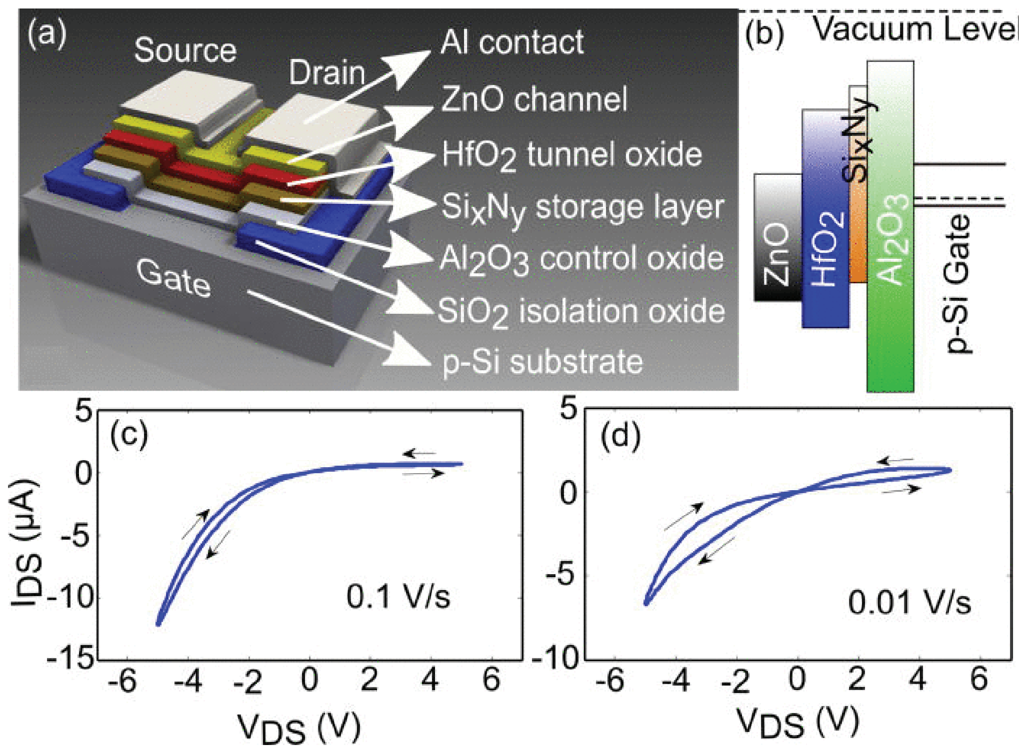
UNAM researcher Assist. Prof. Selim Hanay has published a new paper on advancing the capabilities of nanomechanical sensors in Nature Nanotechnology, widely considered the top journal in the field.

Nanomechanical sensors (NEMS) are engineered, extremely small mechanical structures. Due to their miniscule sizes, NEMS can operate as exquisite sensors of physical changes. NEMS-based mass sensing offered new capabilities for rapid and low-cost characterization of large biomolecules, accomplished at the chip scale.Now, with the research published in the new paper, the capabilities of NEMS sensors have been expanded further. It has been shown that molecules' size and shape, as well as their mass, can be detected by NEMS sensors. The multidimensional information (mass and shape) obtained from the analyte will open up new venues for biomolecular characterization. For instance, the determination of the type of a virus will be accomplished by considering both the weight of the virus and its characteristic shape.

In order to resolve the shape of a molecule, researchers used the higher-order mechanical vibration modes of the sensor and combine the information obtained from all vibration modes. The technique has been verified in experiments using micron-sized cantilevers, as well as in finite-element simulations. Previously, the capability to measure the shape of analytes with inertial mechanical sensors was unknown in the field; this work introduces a paradigm shift in terms of the sensing modalities of mechanical sensors.
http://www.nature.com/nnano/journal/v10/n4/pdf/nnano.2015.32.pdf

Memristor-like operation of thin film Flash memory cells

Memristors, resistors of which conductance is a function of the history of voltage applied to them, have attracted great attention in the present decade as potential components of memory and computing platforms. These long-forgotten device components were predicted over fifty years ago by Leon Chua, who described them as the fourth fundamental circuit element alongside resistors, capacitors and inductors – although the true origins of the memristor are even older than its name, as the term applies to such a broad range of electronic phenomena that the original observations of memristive behavior date over a century ago.



In the modern world, however, memristors are making a comeback: They are expected to play a major role in the development of novel computing platforms, particularly neuromorphic systems, where brain-like (cortical) computational schemes can be efficiently implemented using semiconductor technology.

Recent reports on memristive switches demonstrate improvements in the uniformity and controllability of nanoionics-based memristors, though there is still a long way to go before memristors can compete with other circuit elements in forming neuromorphic systems with billions of synapses and millions of solid state neurons.

In a recent work published in Applied Physics Letters, Dâna Group has demonstrated that junctionless flash memory cells can be operated like a memristor: The write and erase operations commonly performed through voltage pulses applied to the gate can be effected through the application of voltages through the source and drain terminals of the transistor. In fact, the equations that relate the transistor operation and charge/discharge of the floating gate show that the flash memory, when operated in this way, behaves nearly like an ideal memristor. The significance of the demonstration is that it connects the two non-volatile memory device families, the memristor and flash, and may facilitate future applications of flash memory devices in neuromorphic computing. Considering that the density of flash drives has improved to such an extent that multigigabit chips can be mass produced and have entered into virtually every cell-phone, flash technology already has the infrastructure that can enable the implemention of billions of synthetic synapses. Moreover, the flashristor mode -the new operation mode is referred to in the article- can be implemented with high uniformity and repeatability.

http://spectrum.ieee.org/tech-talk/computing/hardware/flashristors-getting-the-best-of-memristors-and-flash-memory

UNAM Researchers Highlighted on the Cover of Angewandte Chemie

Work carried out by a multinational team, led by Prof. Engin Umut Akkaya of the Department of Chemistry and UNAM, was recently selected to appear on the front cover of Angewandte Chemie (April 27, 2015; Vol. 54, Issue 18). The article, "Intracellular Modulation of Excited-State Dynamics in a Chromophore Dyad: Differential Enhancement of Photocytotoxicity Targeting Cancer Cells," has also been labeled a "hot paper" by the editors, based on the referee evaluations.
Angewandte Chemie is one of the most prestigious journals in the field of chemistry. This marks the first time that work from a Turkish university has been featured on its front cover.

The article reports an activatable photosensitizer for photodynamic therapy of cancer. The major novelty is that the design incorporates a glutathione-sensitive switch, which was demonstrated in this work to be preferentially "turned on" in cancer cells as opposed to normal cells.

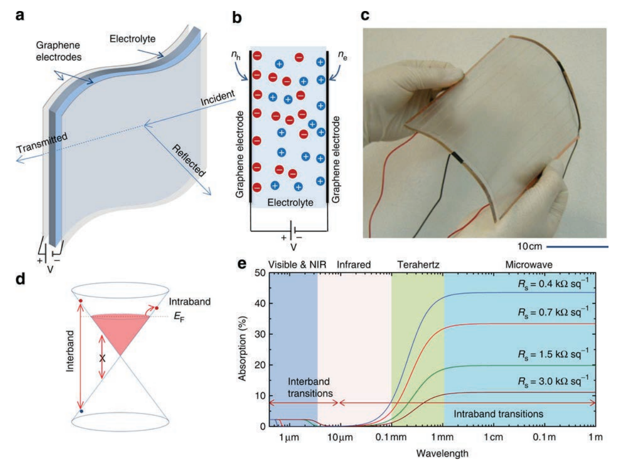
Photodynamic therapy is an alternative cancer treatment modality, which depends on the generation of a reactive and short-lived form of molecular oxygen, following the absorption of light by a compound known as a photosensitizer. Although it has been considered "promising" for a long time, photodynamic therapy has major limitations. The Akkaya group at Bilkent is one of the few research groups in the world addressing these limitations directly. The conceptualization, design, synthesis and chemical and spectroscopic characterization of the compounds, along with the evaluation of their singlet oxygen generation capacities, took place at Bilkent.

UNAM team crafts top-of-the-line detector out of spare parts

Microfluidic devices are required to precisely measure the contents of liquid samples in minute amounts, which is often accomplished by means of optical detection techniques. Electrical droplet sensing, however, can provide a scalable and label-free alternative to conventional methods of microfluidic analysis, and allows the low-cost implementation of multiple sensors within a small area – and Pelin Kübra İşgör and Merve Marcalı, members of the Elbüken Group at UNAM, have developed a capacitive sensor just for the task.

The system employs nothing but off-the-shelf electronics and costs a meager $24 in parts, but the whole is far more than its parts: The new, portable integrated circuit system could rival the sensitivities of bench-top analyzers, providing a new record for the literature at a femtoFarad-level detection capacity. Cheap and flexible, the platform could also handle processes such as analyte dilution and in-chip reactions by mixing two liquids at any given ratio.This system can be used for very precise droplet size and speed detection, as well as droplet counting – also possible is the automated and precise measurement of dielectric content in droplets for biochemical assay monitoring. Being able to effectively characterize the content of microdroplets electrically opens up new avenues for biosensor design, and the team hopes that their research will eventually lead to the impedance spectroscopy of each individual droplet. (http://www.sciencedirect.com/science/article/pii/S092540051500034)

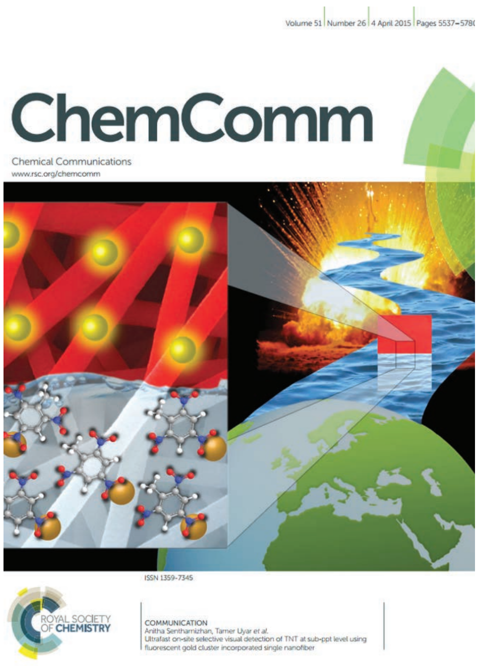
Atomic Coating for Use in Adaptive Camouflage



In recent decades, engineers and scientists have been working on new stealth technologies that make objects less visible to radar detection. Such technologies have generally used passive surfaces to absorb electromagnetic waves. Active camouflage, however, inspired by nature, could provide a perfect means of concealment by allowing an object to blend into the background. Up to this point, the realization of “adaptive” camouflage systems has been hindered by a lack of materials that are active in radar frequencies. Now, a team from the Bilkent University Department of Physics and UNAM, led by Asst. Prof. Coşkun Kocabaş, has successfully developed active radar-absorbing surfaces using atomically thin graphene electrodes. The team discovered a new class of surfaces capable of real-time electrical control of their microwave reflectance. These active surfaces could enable new technologies for adaptive camouflage.

The device developed by the team consists of ionic liquid electrolytes (liquid organic salts) sandwiched between two large-area graphene electrodes. The microwave reflection from the graphene surface can be tuned by the voltage applied between the electrodes. The results of the study have been published in Nature Communications (6:6628, 2015).

Single nanofiber detects sub-ppt level TNT



Explosives are tricky both to handle and to dispose: Although a flask of undiluted nitroglycerin may be an immediate cause for concern, more stable explosives may seep into soil or aquifer systems and damage the environment for years to come. Modern disposal procedures largely prevent the introduction of explosives into the wild, but they are hardly capable of removing what already is present in the soil – and TNT, the go-to explosive for military and industrial applications, has been dumped by the kiloton during its heyday in the past century. The detection and removal of TNT is a major issue for environmental remediation, although such efforts are hindered by the lack of a rapid and accurate method for the on-site quantification of high explosives. Despite momentous advances in the field, a portable and reliable method for quick and selective detection of TNT still poses a challenge to many reasons including inappropriate usage in subordinate areas and untrained personnel – but a recent nanofiber device, developed by Assoc. Prof. Tamer Uyar and his group members Dr. Anitha Senthamizhan and Dr. Aslı Çelebioğlu, may provide the means to develop just such a technique. They have demonstrated the selective, on-the-spot detection of TNT using fluorescent gold cluster-functionalized single nanofiber. Sensitive enough to pick up TNT at one-in-a-trillion (ppt) concentrations, the nanofiber platform is also more stable than its competitors, potentially allowing its use in the field. Moreover, the clear change in the color of the electrospun nanofibrous membrane could be used for the direct colorimetric visualization of TNT, as a result of which, the color change can be visualized by the naked eye in normal light conditions.

The study was published in ChemComm (51: 5590, 2015) and highlighted on the cover

UNAM team harvests light on springs

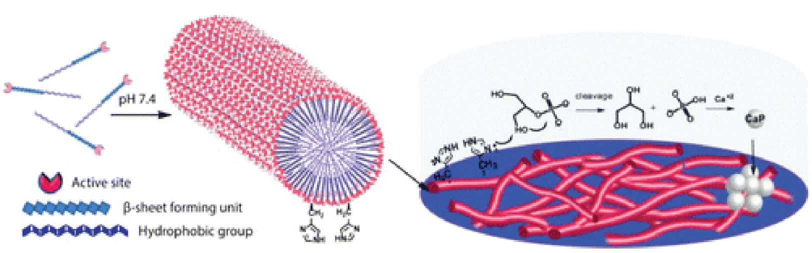
Light harvesting is vital for precisely the sort of devices that would benefit the most from nanotechnology, and Dr. Tural Khudiyev and Prof. Mehmet Bayındır, two researchers at Bilkent University's National Nanotechnology Research Center (UNAM), have recently developed a type of nanomaterial that stands above the rest in the capture of light across the visible range in particular.

Published in the journal Applied Optics, the group's design involves conventional nanowires that are twisted into springs through minor alterations in temperature during the fiber-drawing process used in their production. This configuration allows light-absorbing "hotspots" to form across the length of the spring, which trap incident light through the Mie effect and increase the material's absorption efficiency by 23% compared to non-modified nanowire structures. As with many other nanomaterials, structure diameter appears to be key for this effect: The group's theoretical calculations suggest that optimal absorption occurs for spring diameters between 50 and 200 nanometers, the material's effectiveness tapering out beyond this range and even falling behind that of nanowires for diameters over 400 nm. In addition to single nanowires, theoretical predictions uggest that large arrays of nanosprings may also exhibit enhanced absorption, provided that the spacing length between individual springs is optimized beforehand.

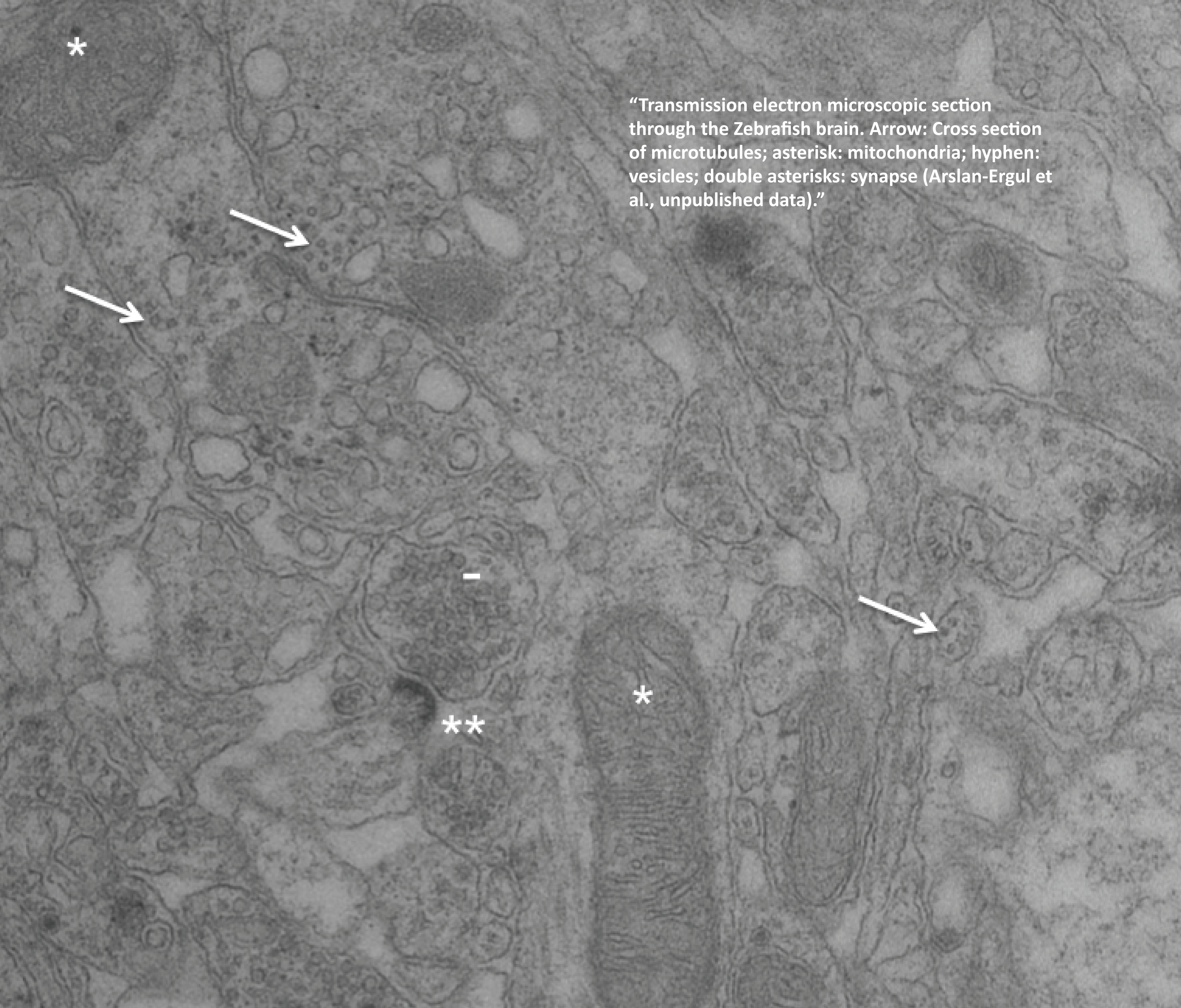
Bayındır also predicts that core-shell nanosprings may reach even higher absorption efficiencies, and suggests that such a scheme would be of considerable use in photovoltaic and photodetector devices that must absorb a high number of photons using as little material as possible. Their research was highlighted by the Reuters and also received international attention from the materials science community by being highlighted in Nanowerk, phys.org, Photon Transfer, Top Wire and other news aggregates.

Enzyme-like peptide networks enhance bone formation

UNAM research teams led by Assoc. Prof. Mustafa Özgür Güler and Assist. Prof. Ayşe Begüm Tekinay have recently reported synthesis of alkaline phophatase mimicking peptide amphiphiles to enhance bone formation *in vitro*. The primary function of alkaline phosphatase is to detach phosphate groups from various organic molecules, which occurs through the activity of histidine amino acids present in its structure. Indeed, these histidines are so vital that they can evidently function in the absence of the rest of the enzyme – the peptide networks developed by the team are little more than a series of histidines in a well-coordinated, one-dimensional array, but nonetheless display a formidable ability to cleave phosphates from an organic substrate. While ALP is found ubiquitously in the human body, it is especially abundant in bone, where the phosphate groups it produces are channeled to the tissue biomineralization process – and ALP-mimetic peptide networks are also capable of replicating this function, driving preosteoblast cells to differentiate into mature cells and start forming bone nodule-like structures.



RESEARCH GROUPS

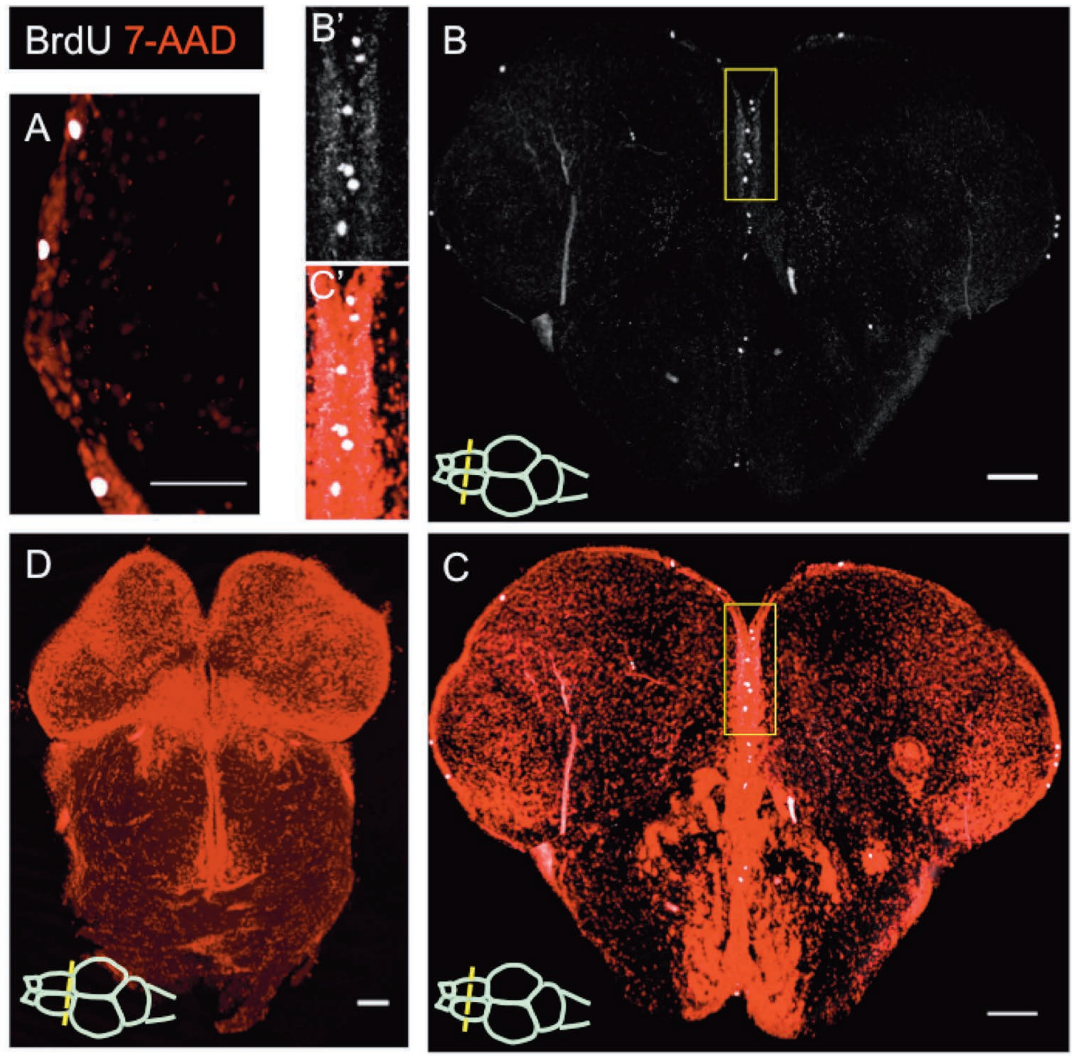


“Transmission electron microscopic section through the Zebrafish brain. Arrow: Cross section of microtubules; asterisk: mitochondria; hyphen: vesicles; double asterisks: synapse (Arslan-Ergul et al., unpublished data).”

Age-Related Changes in Synapses and Dietary Interventions

Dr. Adams' research focus is aimed at understanding age-related alterations in synapses and the effects of caloric restriction (CR) in preventing these changes. We aim to determine the molecular pathways through which CR is exerting these effects to develop possible drug mimetics that would be translatable to human populations.

Aging is a complex process, regulated by the interplay between genetic and environmental factors with multifactorial changes affecting many systems. Normal aging is accompanied by cognitive decline and understanding the mechanisms at the synaptic level will provide insight into the biological changes that underlie this decline. Developing strategies for ameliorating and preventing cognitive changes and potential translational therapies for the aging population are important goals. Caloric restriction (CR) is a dietary regimen that is based on lowering the daily caloric intake. CR animals have higher mean life and health spans, delayed age-related physiological changes, and better performance on memory tasks. The differential effects of CR, such as the gender of the subject, timing and duration, as well as the specific molecular mechanisms of CR are unknown. Also, development of potential CR-mimetics, drugs that mimic the effects of CR, is important. We are using the zebrafish as a model organism to study the effects of aging and CR because just like humans they age gradually and many genetic tools are available. We observed that synaptic protein levels show a sexually dimorphic pattern with brain aging. We have begun to apply CR and CR-mimetics to determine the molecular pathways of these interventions.

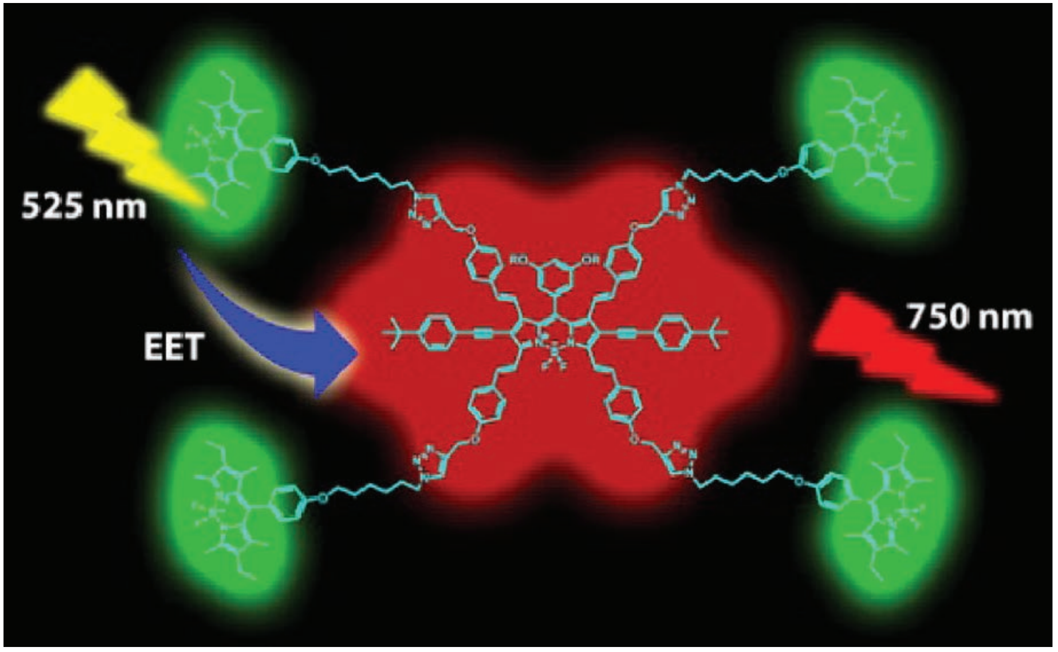


Supramolecular Chemistry and Chemical Nanotechnology

Rational design of molecular or supramolecular structures with emergent functionalities is the primary target of our research efforts. To that end, we are trying to find practical applications for molecular logic gates, develop autonomous activation protocols for biologically active organic compounds and photochemically modulate various chemical and physical properties of molecular systems.

Our research group has contributed to the development of molecular logic gates over the years. We, among a few others are convinced that the first unequivocal application will present itself in the nanomedicine field. One particular field of inquiry which could benefit from such fusion of ideas is photodynamic therapy. Photodynamic therapy (PDT) is a non-invasive method of treating malignant tumors and age-related macular degeneration, and is particularly promising in the treatment of multidrug-resistant tumors. The PDT strategy is based on the preferential localization of certain photosensitizers in tumor tissues upon systemic administration. The sensitizer is then excited with red or near infrared (NIR) light, generating singlet oxygen ($^1O_2$) and thus irreversibly damaging tumor cells. One important aspect is the tight control of the delivery of cytotoxic singlet oxygen to be produced. In an earlier design, we proposed a sensitizer which behaves as an "AND" logic gate. Singlet excited state of the sensitizer dye can take a number of different paths for de-excitation, through competing processes. Among these processes, photoinduced electron transfer (PeT), intersystem crossing, fluorescence, non-radiative de-excitation are the most prominent ones. The rates of fluorescence or non-radiative process are not affected by the modulators such as Na^+ and H^+. But, the blocking of PeT by Na^+ binding to the crown ether moiety, leaves intersystem crossing as the major path for de-excitation. This is path for singlet oxygen generation. So, increasing concentration of Na^+ ions increases the rate of singlet oxygen generation. H^+ ions influence the same rate by a different mechanism, the added acid causes a bathochromic (red) shift in the absorption spectrum. This shift moves the absorption peak to the peak emission wavelength of the LED used in the excitation. Thus, the sensitizers are more effectively excited when the medium is acidic. Although this is a proof of principle study, we already established the fact that, molecular logic holds a greater promise than previously recognized.

"A convincing application" is sorely missed in the field of molecular logic gates. In most examples, the assignment of logic gates, especially in more complex systems, is "ex post facto", resting on finding a suitable digital design that is in accordance with spectral changes. We design independently functional logic gates and then cascade (or integrate) them by a singlet oxygen signal. In addition, the resulting cascaded gates function in nanospace (inside a micelle) as a singlet oxygen generator, which also reports the rate of singlet oxygen generation. This has clear therapeutic implications within the context of photodynamic therapy.



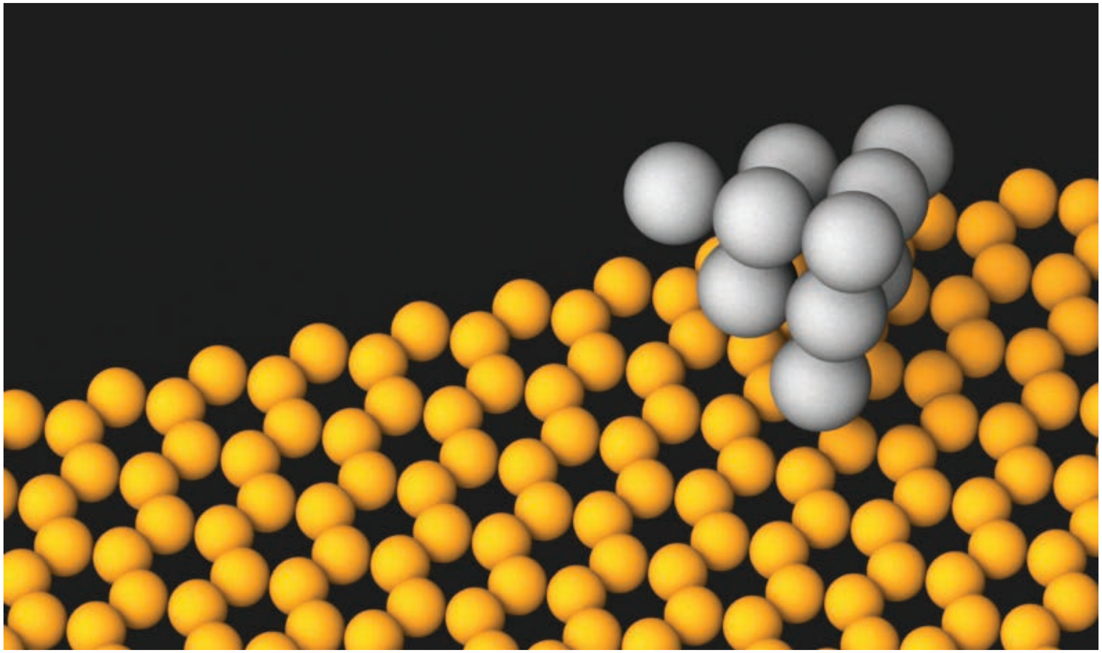
“We design independently functional logic gates and then cascade (or integrate) them by a singlet oxygen signal.”

“Scanning probe microscopy provides a unique window to the atomic-scale world of surfaces, through which fundamental processes associated with diverse phenomena such as friction and catalysis may be observed.”

Dr. Mehmet Z. Baykara

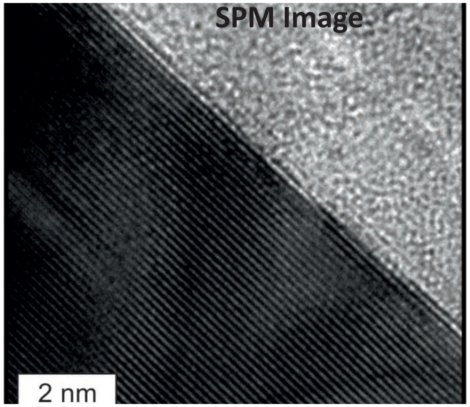
Scanning Probe Microscopy (SPM)

Various phenomena of scientific and technological importance such as friction, adhesion, corrosion, and heterogeneous catalysis take place at material surfaces. A full understanding of the fundamental principles governing such processes requires detailed knowledge of the nanoscale structural, mechanical, physical, and chemical properties of the surfaces involved. In our research group, we apply and further develop scanning probe microscopy techniques to study a variety of material surfaces and associated phenomena on the nanoscale.



Nanotribology

Despite the fact that friction is ubiquitous in our daily lives, the fundamental physical laws that govern it are still not well understood. Motivated by the idea that an ability to predict and control friction on macroscopic scales depends on a complete understanding of frictional processes occurring at the nanoscale, the research area of nanotribology (the science of friction, wear, and lubrication on the nanoscale) has been formed.



In our research group, we study (i) the frictional properties of two-dimensional materials such as graphene and (ii) the nanotribological behavior of metallic nanoparticles on substrates such as graphite by atomic force microscopy based experiments. By studying friction as a function of interface structure and chemistry, we contribute to the further development of friction laws on the nanoscale. In particular, we are currently involved with the experimental validation of superlubric sliding under ambient conditions.

Probe Effects in Atomic Force Spectroscopy

Despite the vast potential of scanning probe microscopy in exploring the atomic-scale physical properties of material surfaces, issues such as structural asymmetry and elasticity of the probe apex as well as cross-talk in multichannel experiments cause significant problems in correct interpretation of results.

In our research group, we utilize numerical simulations to study effects associated with tip structure and elasticity in atomic-resolution scanning probe microscopy experiments. In particular, we have recently verified that erroneous conclusions about atomic-scale surface properties can be readily drawn on samples such as graphene when asymmetric and soft probe tips are utilized during combined atomic force/scanning tunneling microscopy measurements.

Dr. Bilge Baytekin

Mechanochemistry

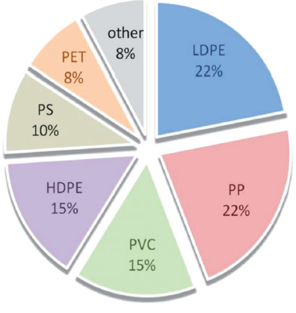
In our research group, we develop new materials and methods to efficiently convert mechanical energy to chemical energy.

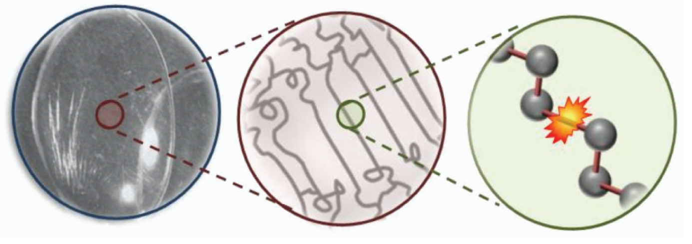
Mechanochemistry

Mechanochemistry is the conversion of mechanical energy exerted on materials (i.e. tension, compression, or even a simple contact of two surfaces) to chemical energy via chemical bond breakages. The increasing demand for finding new energy sources and ever-increasing value of feedstock materials recently boosted the interest in mechanochemical research for finding new pathways for energy conversions and development of new technologies e.g. in the field of recycling. Our research group aims to find such systems to perform efficient mechanical-to-chemical energy conversions.

Polymer mechanochemistry

Growth in the production of polymeric materials (reaching 245 million tons per annum as of 2009, with estimated worldwide sales of $454 billion, which are expected to reach $567 billion by 2017, with an average growth rate of 3.8% between 2012 and 2017) and the expansion of their uses make polymers a primary class of materials. Polymer mechanochemistry has recently gained more importance with the growth in production of polymer materials as well as with the growing interest in retrieving energy from organic/polymer materials. In our group, we both work on mechanochemistry of the common polymers produced and used in large quantities everyday, and also produce new materials and methods that will finally be reflected in innovative technologies i.e. in energy conversion and recycling.





Polymer mechanochemistry: versatile and efficient. In the figure: A Nike Air shoe sole filled with a pre-florescent dye fluoresces upon walking.

"Revealing physical and chemical changes on the surfaces at the molecular level help us to find solutions to the problems such as static electricity, friction and wear."

Triboelectricity and Tribochemistry

The research interest of our group consists of all electrical, physical, and chemical changes that happen when surfaces get into contact. We examine, analyze and tailor surfaces at molecular and nano level to effect their properties in the macro dimensions and reflect these on applications in the various technologies e.g. electronics, air-space, and polymer manufacture. Our state-of-the art research aims to find answers to scientific questions that have been asked for centuries, as well as to produce valuable products using these answers.

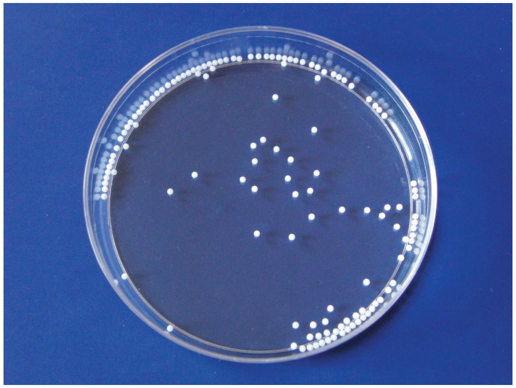
Triboelectricity of Polymers

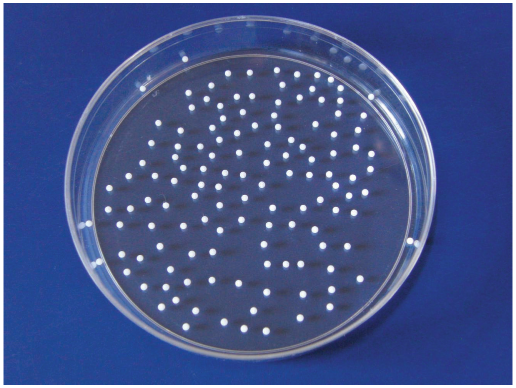
Polymers are the most encountered materials in our everyday life with a rapid growth of utilization. The versatility of the uses of polymers, from spacecrafts to ordinary plastic bags, the variety of chemical and physical properties and their dependence on environmental conditions hinder a better understanding of the electrical behavior of the (dielectric) polymer surfaces. Nevertheless, we have recently shown that it is possible to build a systematical understanding of electrical properties of polymers, especially on their electrostatics, and to find a way to control electrification successfully.

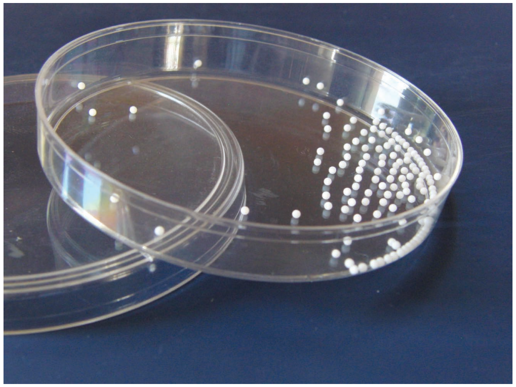
It is a millennia-old problem to understand the electrification of insulators. Our group contributes largely in finding out solutions for this question on the fundamental basis. Moreover, we develop new methods based on this knowledge to mitigate polymer electrification. These methods can be useful in many technologies, where polymers get into play, such as textile, plastic manufacturing, air and space industries.

Tribochemistry

On every contacting surface chemical changes take place, depending on the nature of contact. These changes cause many problems and economical loses in industry e.g. in automotive industry. In our group, we also work on preventing these losses and to increase efficiency of work done by such surfaces.







Dr. Mehmet Bayındır

Nanoscale Materials and Nanophotonics Laboratory

In our group, researchers from a variety of fields, such as molecular biology, chemistry, physics, materials science and electronics collaborate and develop new concepts at the edge of applied sciences. Our group particularly focused on fabrication of ultra-long and aligned nanowires and their device integration, development of optical methods for chemical and biological sensing, and nanostructured surfaces with variety of functionalities.

A new nanofabrication technique

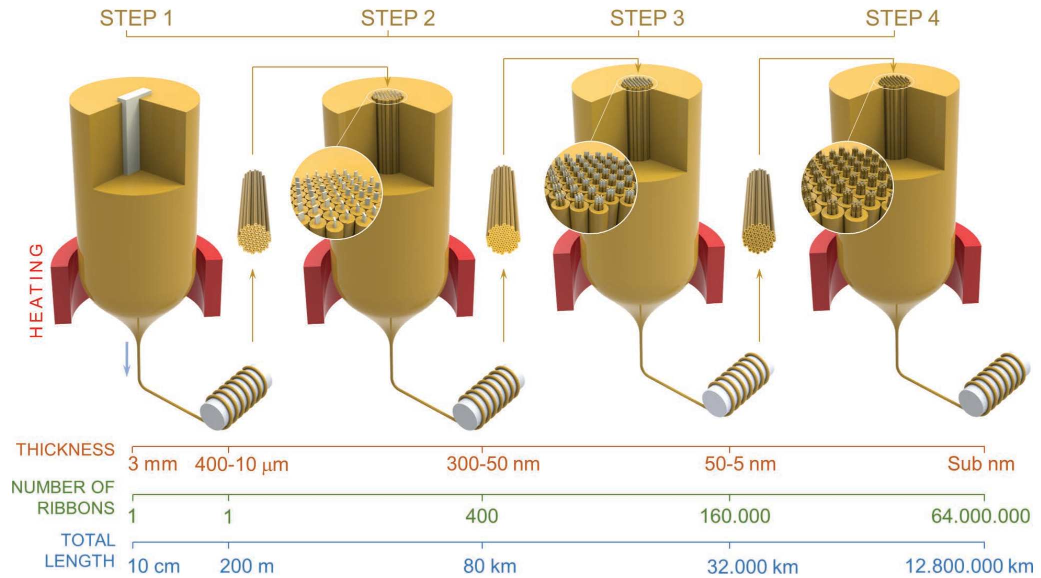
Nanowires constitute an exciting research field in nanotechnology, regarding their unprecedented characteristics compared to their bulk counterparts. Although fabrication and characterization of nanowires are quite well-established, serious problems persist in large scale integration of nanowires into functional devices, impeding their utilization in practical applications. Nanowires that we produce by iterative thermal size reduction, on the other hand, have a significant superiority, thanks to their intrinsic spatial order and exceptional length.

Chemical and Biological Sensing

We exploit interdisciplinary environment of UNAM to develop novel single molecule detection systems and artificial olfaction technologies. In microoptics sub-group we employ very high quality factor microcavities and measure the wavelength shift in the optical signal due to analyte introduction. This approach, combined with the surface modification of micro-toroids, can detect even single molecules selectively. In the photonic nose sub-group we work on a distinct opto-electronic nose concept introduced in our laboratories. This concept utilize an array of opto-fluidic hollow-core infrared fibers in order to measure infrared absorption of volatiles in a compact scheme.

Functional Nanostructured Surfaces

Nanoengineering of surfaces holds a great deal of promise for many high-tech applications including solar cells, self-cleaning windows, and chemical and biological sensors. We are producing these surfaces for variety of purposes such as to enhance the efficiency of solar cells, to produce rapid explosive sensors and to prepare reproducible SERS substrates. Also, we are collaborating with industry in order to produce surfaces that are resistive against water condensation and ice adhesion.



Reinvention of fiber drawing in the age of nanotechnology: Production of indefinitely long nanostructures which pave the way for novel applications, including nanowire-based large-area flexible sensor platforms, phase change memory, nanostructure-enhanced photovoltaics, semiconductor nanophotonics, dielectric metamaterials, linear and nonlinear photonics and nanowire-enabled high-performance composites.

"Reinventing the fiber drawing process, we exploit applications of indefinitely long nanowires in the field of nanotechnology."

"Atomic layer deposition technique is exploited to synthesize functional III-Nitride and metal-oxide thin-film and nanostructured coatings for a variety of semiconductor device applications."

Dr. Necmi Bıyıklı

Functional Semiconductor Materials and Devices

Our research focus extends from the growth and characterization of micro/nano-scale functional compound semiconductor materials including III-Nitride and metal-oxide alloy families to the design, fabrication, and characterization of enabling devices for a variety of applications including sensor technologies, flexible and transparent electronics, renewable energy, wireless communication, and national security.

In our group, we start with the growth/synthesis of functional semiconductor materials in either thin film or nanostructured forms using mainly two materials growth techniques including chemical vapor deposition (thermal and plasma-assisted atomic layer deposition) and physical vapor deposition (DC/RF-sputtering). Growth recipes for a variety of compound semiconductor alloys including III-Nitride and metal-oxide families are being optimized through a detailed materials characterization process including structural, chemical, optical, electrical, and surface/morphological characterization tools. With the optimized recipe parameters in our hand, we target to produce a variety of devices including chemical and biological sensors, micro/nano-electromechanical actuators, electronic and opto-electronic passive and active components, photo-catalysis coatings, organic/inorganic solar-cells, reconfigurable RF components, etc. Our main target is to contribute both to the materials and device aspect of semiconductor research:

Semiconductor materials research by investigating alternative growth techniques and combining our techniques/materials with inter-disciplinary methods/materials to produce novel micro/nano-scale functional semiconductor materials.

Semiconductor device research by using the developed materials and standard micro/nano-fabrication tools and processes, developing alternative devices for a variety of applications including but not limited to sensing, flexible and transparent electronics, renewable energy, wireless communication, and national security.

Dr. Aykutlu Dâna

Plasmonic Sensors and Imaging

Plasmonics brings together light and metallic nanostructures to harness the benefits of electromagnetic modes of such nanostructures. Plasmonics allows control of the optical properties of surfaces and have been useful in a number of fields such as on-chip optical signal routing, biosensors, surface enhanced Raman and infrared spectroscopies. We focus on designing and realizing plasmonic surfaces for biomolecular sensing down to the single-molecule level.

From the Lab into your palm

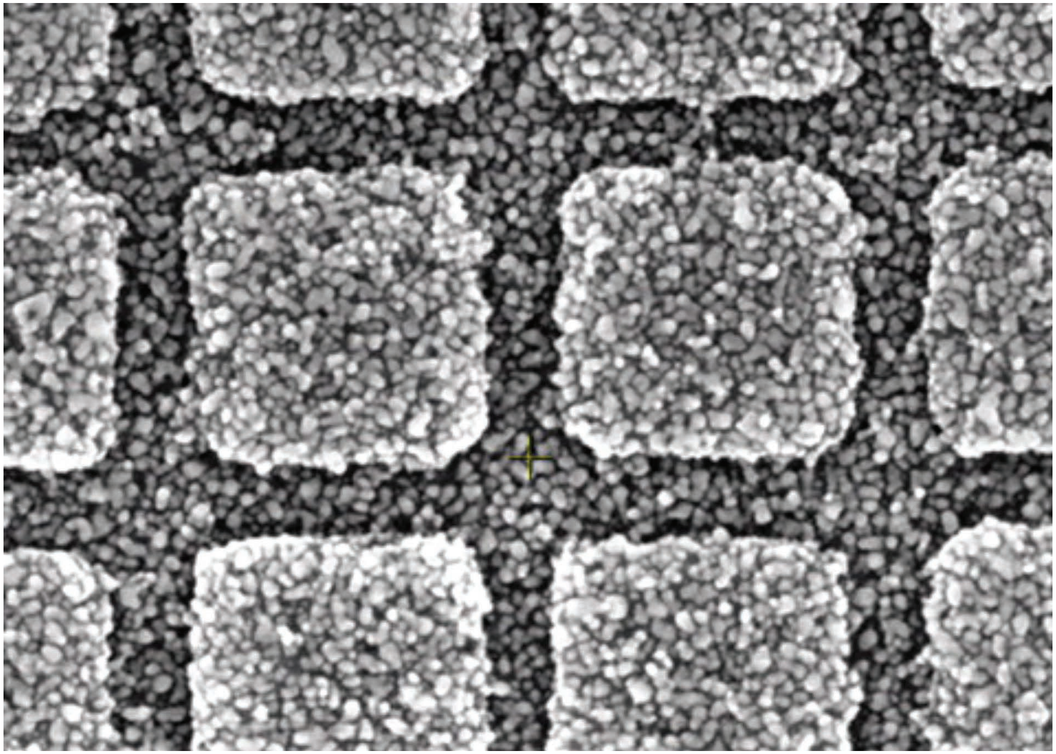
Thanks to the ever continuing development of microelectronics, we now live in an age where almost everyone carries a powerful computer, be it a mobile phone or a tablet. We use electromagnetic design and nanoscale structuring to produce surfaces and systems that enable Plasmon resonance based imaging and spectroscopy on mobile platforms. Surface Enhanced Raman Spectroscopy (SERS) is among the techniques we use to detect single molecules and their chemical fingerprints. Our surfaces allow easy production and highly repeatable SERS, that can even be detected using a cell phone camera. We demonstrate that airborne molecules can be sensed on our substrates, and potentially identified based on their Raman spectra.

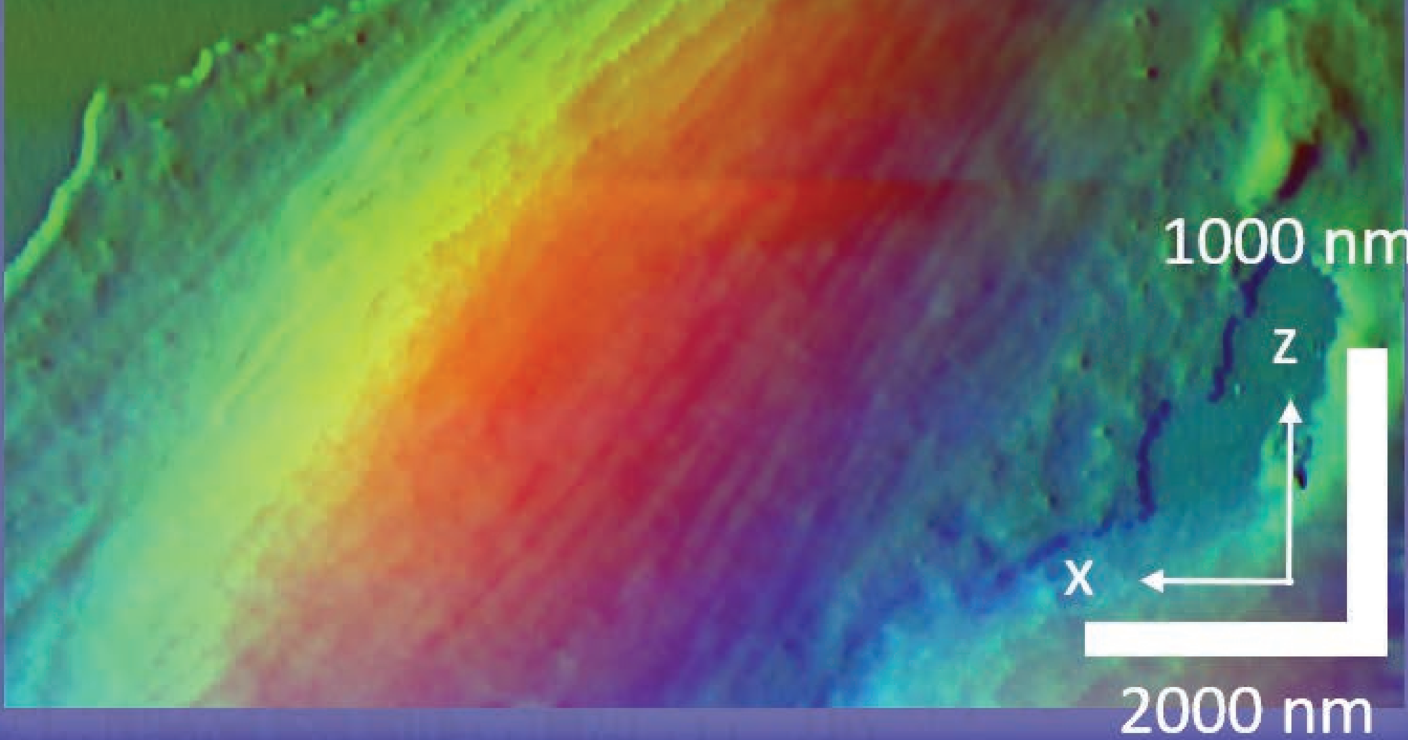
Label-free imaging beyond the diffraction limit

Although optical microscopy has been particularly beneficial in biology, the so-called diffraction limit prohibited imaging of structures much smaller than the wavelength of light. This posed a limitation in the use of microscopes, which can image living things in their native environments, in imaging sub-cellular structures and activity of molecular machines. Optical microscopy is now experiencing a revival with the advent of superresolution imaging, i.e. imaging beyond the diffraction limit. We have used high density and uniformity plasmonic substrates to implement a label-free version of stochastic superresolution imaging, based on SERS. The resulting technique provided a resolution of 20 nm, and potentially allows superresolved acquisition of label-free chemical fingerprints of the imaged structures due to the chemical specificity of the Raman effect.

Surface Plasmon Resonance Imaging with disposable substrates

Many of the tests in healthcare rely on detection of the concentration of biomolecules in serum. Surface Plasmon resonance has been a valuable tool, used in biochemical interaction analysis and sensing, for over three decades. We use nanostructured surfaces prepared by nanoimprint lithography for array sensing using the surface plasmons. The readout system is miniaturized and integrated with a mobile phone, allowing simultaneous detection of multiple biomolecular agents using a low-cost hand-held system.



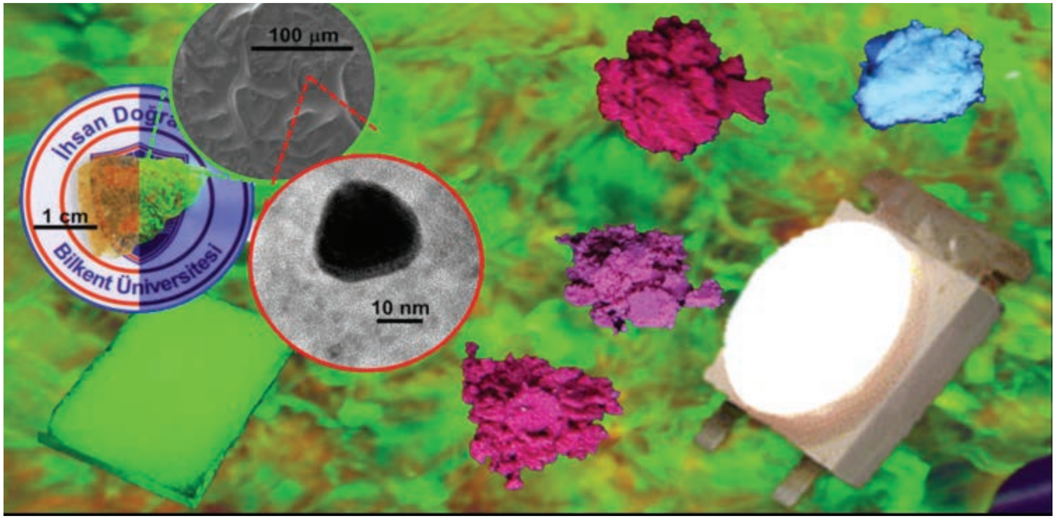


In 2015, Dana group developed a technique for high speed mechanical characterization of soft matter. The method relies on high speed force distance mapping using magnetically actuated cantilevers with well defined tip radii. In a seperate work, high performance substrates were developed for infrared absorption spectroscopy of protein monolayers. These substrates were shown to outperform optimized plasmonic substrates in terms of overall signal intensity. The research extends to the use of a portable infrared imaging system attached to a mobile phone. A miniature infrared spectrometer was built using a bolometer array and a specially designed grating. Combining the high performance substrates with mobile infrared spectrometry, proteins can be characterized and detected on the go.

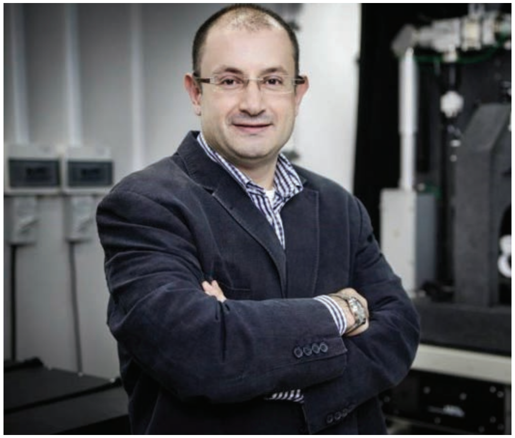
Dr. Hilmi Volkan Demir

Quantum Devices and Sensors Laboratory

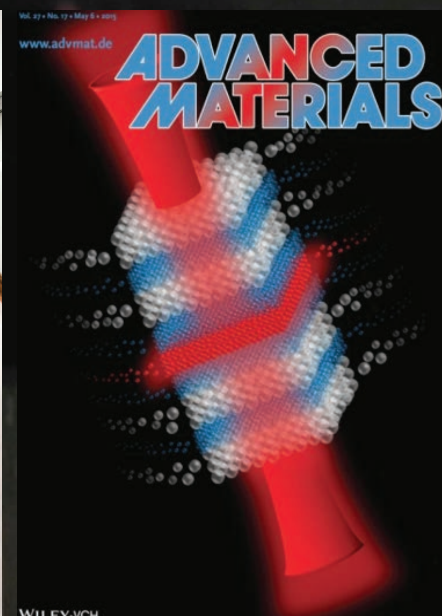
The Demir Research Group is working on innovative nanophotonic and optoelectronic materials, devices, and platforms, embedded with nanoscale functional structures especially focusing on quantum optoelectronics of atomically-flat nanocrystals and colloidal quantum dots, physics of colloidal nanophotonics (excitonics, plasmonics), energy-transfer driven quantum devices/sensors, nanoparticles photonics, light-emitting diodes, quality lighting, sensing bioimplants, implantable medical devices, under the supervision of Professor Hilmi Volkan Demir.

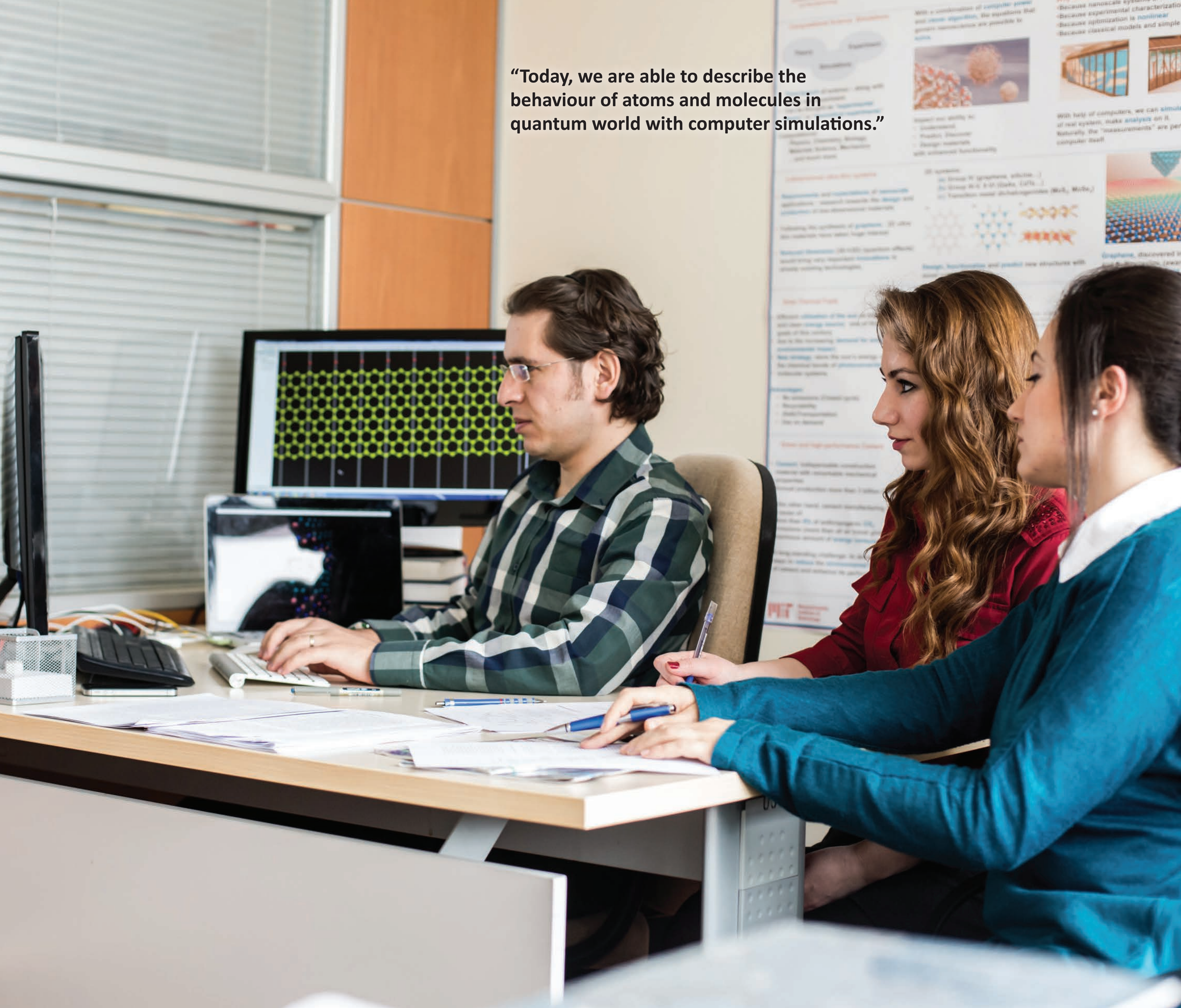


The Demir Group's research work has advanced the scientific knowledge and technology benchmarking in semiconductor nanocrystal lighting. The team studies materials from synthesis to property characterization and device applications with its cutting edge soft-material synthesis, material characterization and device fabrication systems. These enable to establish world-class expertise and generate new technologies spanning from materials to systems, with the targeted applications in color-enrichment for displays, quality indoor lighting, spectrally enhanced outdoor lighting, flexible and bendable displays, and tunable lasers. The team developed the capability to synthesize various types of colloidal QDs including II-VI (CdSe, CdTe, etc.) and III-V material systems (InP). One important technological breakthrough resulting from the Demir's Group colloidal nanocrystal research is the first demonstration of the spatially and spectrally coherent, well-defined laser beam emission from an all solution-processed vertical-cavity surface-emitting laser, at a record low threshold in frequency up-converted regime. This work appeared in Advanced Materials 27, 2741 (2015, ACS Nano 8, 6599 (2014), J. Phys. Chem. Lett. 5, 2214 (2014). Another important scientific advancement enabled by the Demir Group's research is the incorporation of nanocrystals into crystalline matrices. With this method, the team successfully obtained light-emitting powders of nanocrystals having significantly high quantum yields and extraordinary emission stability at high temperatures [Nanoscale, 2015]. Utilizing a similar platform, the group also directly co-immobilized nonpolar green- and red-emitting nanocrystals into ionic salts and obtained an excitonically improved LED having luminous efficiency >70 lm/Welect [Opt. Express, 2016]. To benefit from the anisotropic optical features of the host crystals for isotropic emitters, the team incorporated red-emitting nanocrystals into blue-emitting anthracene crystalline host, which has a well-known optical anisotropy. The resulting material system exhibited a polarization ratio of 2.5 [J. Phys. Chem. Lett., 2015]. Finally, to realize a robust and large dimensional plasmonic crystal, the group hybridized gold and semiconductor nanocrystals within sucrose macrocrystals and improved the quantum yield of the nanocrystals by 58% via plasmonic interplay [Nano Res., 2015]. The Quantum Devices and Sensors Laboratory believe that this novel robust material system will find ubiquitous use in photonic devices in the near future.



Guzelturk et al. proposed and demonstrated very high performance and extremely stable optical gain media using tailored CdSe-core/CdS-shell quantum dots (QDs) via both single- and two-photon absorption pumping. For the first time, the spatially and spectrally coherent, well-defined laser beam emission from an all-solution-processed laser is presented especially at a record low threshold in frequency up-converted regime.





“Today, we are able to describe the behaviour of atoms and molecules in quantum world with computer simulations.”

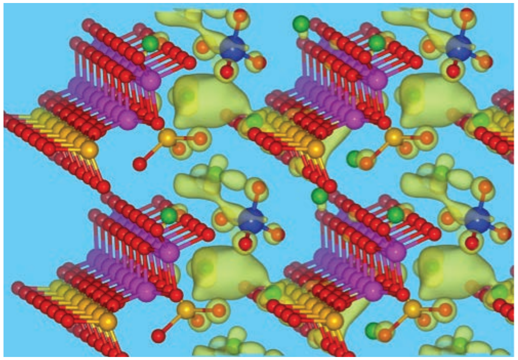
Dr. Engin Durgun

Computational Nanoscience

We are working in the multidisciplinary field of computational science, which intersects physics, chemistry, and materials science. We focus on the application of state-of-the-art modeling and simulation tools to understand, predict, and design novel materials systems to address critical challenges of global importance. We are particularly interested in investigating 2D materials at the nanoscale, the design of solar-thermal fuel systems, and the study of green and high-performance cement.

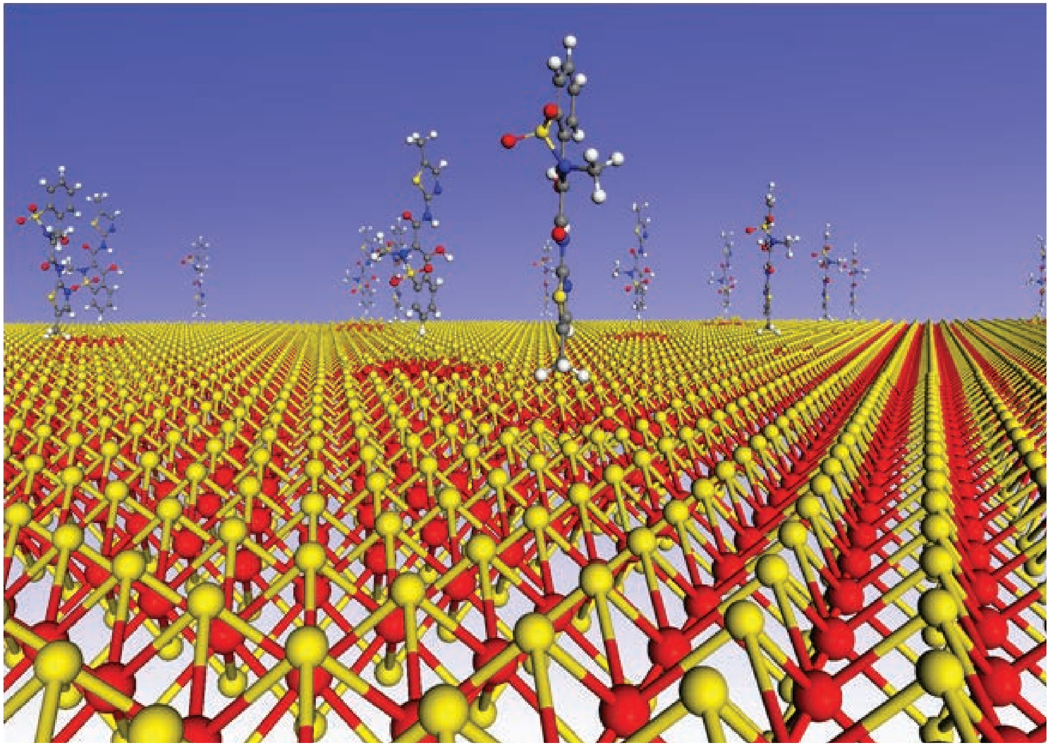
Green and high performance cement

Cement is the cause of more than 8% of global CO_2 emissions, and yet, while it is one of the most common materials in use, we have remarkably little understanding of its microscopic properties. To reduce the environmental footprint and enhance its performance a greater fundamental understanding down to the scale of its electronic properties is essential and required. We are suggesting a bottom-up approach to modify the properties at the nanoscale for new generation cement.



2D ultra-thin systems

Following the synthesis of single-layer graphene and demonstrations of graphene-based device applications, two-dimensional ultra-thin materials have become the focus of both experimental and theoretical studies. Interesting quantum effects provided by the reduction of dimension of the bulk materials to two-dimensional form would bring very important innovations in already existing technologies. In this framework our main goal is to design, to functionalize and to predict possible applications of these novel systems.



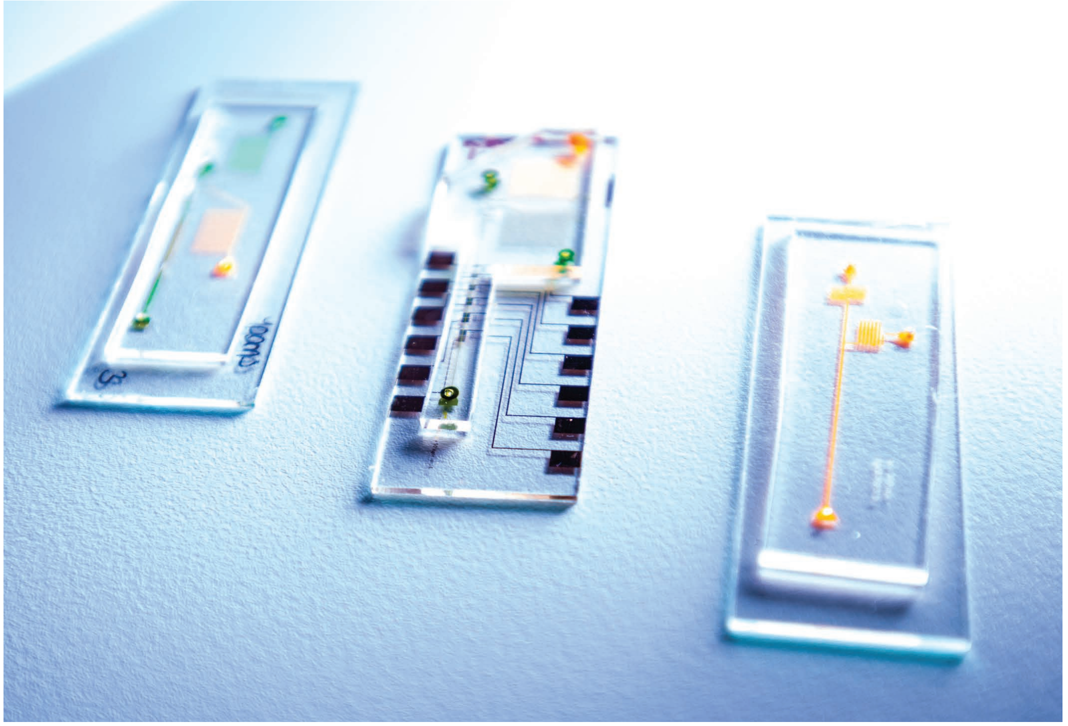
Solar-thermal fuels

Efficient utilization of the sun as a renewable and clean energy source is one of the greatest goals of this century. An alternative and new strategy is to store the solar energy directly in the chemical bonds of photoconvertible molecular systems. We suggest different approaches and ideas to design materials for solar fuel applications and investigate methods to increase the energy storage capacity and life-time of the product.

Dr. Çağlar Elbüken

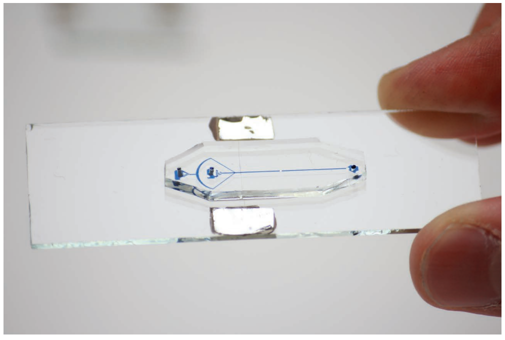
Micro/Nanofluidics and Lab on a Chip Systems

We are working on developing fundamental understanding and applications of fluid flow at small scale. We are specifically interested in control of biological liquids with extreme precision. Exquisite control of nanoliter size fluid packages enables high throughput studies using minute amounts of samples. Such systems address a broad range of applications. We explore applications in single cell studies.



Microdroplet based systems

Recently, we have developed microdroplet based platforms that utilize two phase flow. We are combining these systems with portable electrical sensors for real-world applications. Using these systems we can study viability of biological samples in nanoliter sized microdroplets under different buffer conditions. Integration of these systems with low-cost electronics opens the avenue for rapid diagnostic and screening applications. The system we are developing is especially powerful in assays requiring high througput. The system is reprogrammable, i.e. the size and the speed of the droplets generated can be fine tuned in pico/nanoliter range. The system can be automated to measure the viability of cells in each and every droplet. We are interested in applying this system to study antibiotic resistance of single cells and cell colonies.



Point-of-care diagnostics

We are also working on point-of-care diagnostic devices. Point-of-care devices are becoming more popular due to raising interest in personal health. Development of these systems requires a deep understanding of fundamental fluid flow mechanisms and enabling sensing technologies. Currently, we are working on a mobile platform for detection of cardiac troponin-I, which is a biomarker for rapid diagnosis of myocardial infarction.

“Microfluidic systems combined with electrical detection mechanisms enable high throughput, automated study of biological and chemical processes.”

"Complex and genetic metabolic diseases are modeled in transgenic mouse models to test novel therapeutic targets and diagnostic approaches for atherosclerosis, diabetes and obesity."

Dr. Ebru Erbay

Novel Therapeutics & Diagnostics for Cardiometabolic Syndrome

My laboratory's research focus is at the intersection of nutrient-sensitive, inflammatory and stress pathways in the context of chronic inflammatory and metabolic diseases such as obesity, diabetes and atherosclerosis. Our goal is to identify novel therapeutic targets and biomarkers for this disease cluster. Our multidisciplinary approach includes molecular biology, chemical-genetics, RNA-sequencing, proteomics, metabolomics, transgenic mice, advanced imaging and nanobiotechnology methods.

How do the excess of nutrients engage inflammatory and stress pathways in cells and lead to the development of chronic metabolic and inflammatory diseases? One clue is the chronic overloading of anabolic and catabolic organelles by nutrients leads to metabolic stress. Indeed, metabolic overload leads to endoplasmic reticulum (ER) stress and activates the unfolded protein response (UPR). We are interested in ER's unconventional mechanisms of sensing lipids and its role in coupling nutrients to inflammatory responses. Our major goal is to probe the molecular differences between the detrimental consequences of metabolic ER stress and the adaptive UPR signaling that could be therapeutically exploited in chronic metabolic diseases. The UPR consists of three branches, however, specific tools to control any of these arms are not available. Our approach to this problem involves using chemical-genetics to specifically modulate the activities of proximal kinases in the ER stress response. This method allows mono-specific activation or inhibition of only the modified kinase in cells and tissues in vivo. This will be coupled with substrate discovery and creation of transgenic mouse models.

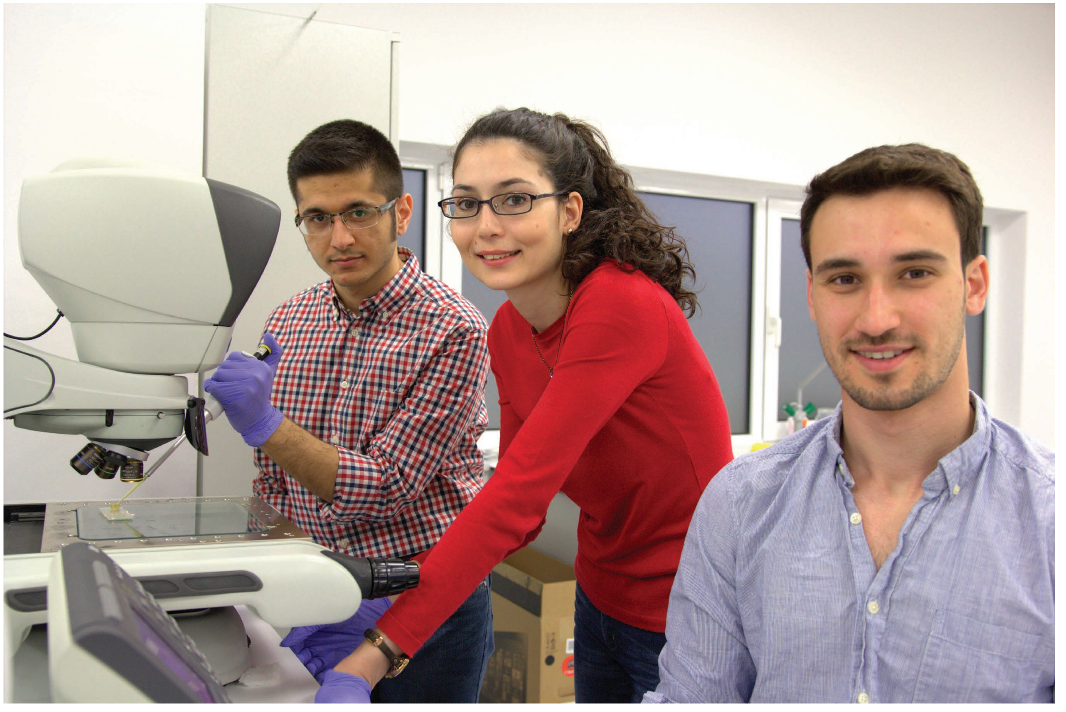
Dr. Yegân Erdem

Micro and Nano Integrated Fluidics (MiNI) Lab

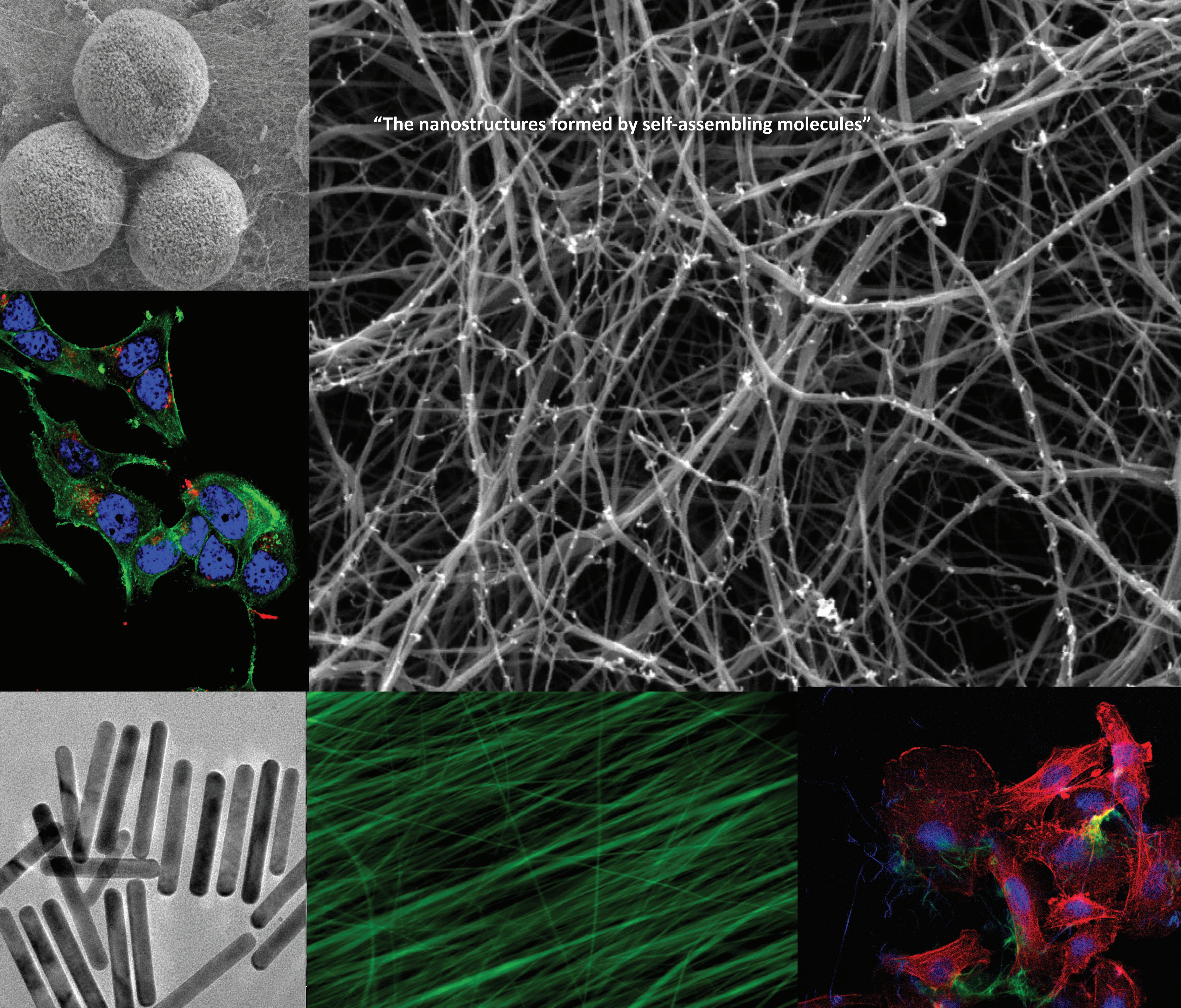
MiNI Lab focuses on using microfluidics as a tool for nanotechnology applications. The main focus is nanomaterial synthesis, manipulation and printing via microfluidics. Current techniques for nanomaterial synthesis lacks the ability to control reaction conditions, resulting in polydispersity. Microfluidics not only provides a controlled environment for synthesis but also the ability to perform post-processing such as shell coating or functionalization.

MiNI Lab is a research group that brings microfluidic solutions to nanomaterial technology. Nanomaterials such as nanoparticles, nanorods or nanowires, have unique properties that highly depend on their size; therefore it is crucial to be able to perform synthesis reactions with superior control over reaction conditions to achieve monodispersity. Monodisperse particles can be later functionalized and printed on surfaces to form sensors, or other smart surfaces. In MiNI Lab there are two approaches for microfluidic systems for the synthesis and manipulation of nanomaterials. The first one is microchannel based approach, where solvents are passed through channels and synthesis is based on the mixing and heating of these solvents inside the channels. The second approach is the surface approach, where droplets are moved on a textured surface without being enclosed in a channel. By creating local energy gradients on the surface, droplets of liquid can be manipulated by supplying an external energy such as vertical vibration of the surface. With the second approach, nanomaterial synthesis can be realized in small droplets and later these droplets can be carried to specific locations for immobilization and printing.

In the MiNI Lab we plan to develop microfluidic networks for assembling nanomaterials on substrates to create smart surfaces. Nanomaterials can be delivered to specific locations by using a combination of microfluidic channels and textured surfaces. Once they are delivered to the location, the solvent can be evaporated selectively. By using this network, different nanoparticles can be assembled on the same substrate at precise locations. This method is a mechanical way of assembling nanoparticles therefore it is independent of substrate material and does not require chemical modification of the surface. These smart surfaces have two application areas. The first application area is biosensing. Functionalized nanoparticles with biomolecules are used for biosensing applications to enable point-of-care diagnostics. The second promising application area of these smart surfaces is energy harvesting from random mechanical motions.



“MiNI Lab brings microfluidic solutions to nanomaterial technology.”

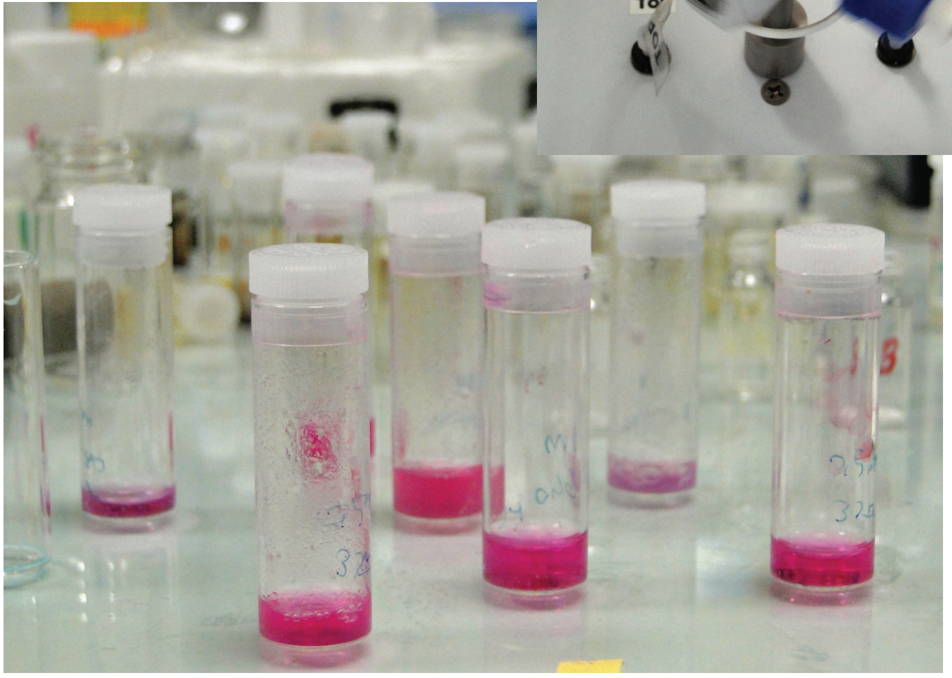

"The nanostructures formed by self-assembling molecules"

Dr. Mustafa Özgür Güler

Biomimetic Materials Laboratory

Research at Biomimetic Materials Laboratory (BML) is based on discoveries at the interface of chemistry, biology, and materials science. We study concepts of making smart materials, which mimic the structure and function of the biological materials through programmed self-assembly of small molecules. Development of self-assembled biomimetic materials and integration of these materials to the material science applications are appealing motivation of our studies. BML group incorporates diverse scientific disciplines and collaborates with different research groups

Self-assembly is an important technique for materials design using non-covalent interactions including hydrogen bonds, hydrophobic, electrostatic, metal-ligand, π-π and van der Waals interactions. Various self-organized supramlecular nanostructures have been produced by using these non-covalent interactions. Diverse functional groups can also be incorporated into nanostructures, for example bioactive peptide sequences and metal chelating groups as well as hydrophobic motifs that include alkyl chains, steroid rings, and aromatic systems. The potential impact of these nanostructures on biomaterials, regenerative medicine, drug delivery, bio-imaging, biophysics, biomechanics, catalytic systems and photovoltaics is being studied.
Understanding of the supramolecular architecture of peptides, proteins and other cellular components is of vital importance in life sciences research and may facilitate better understanding of structure-function relations in biological systems. The novel systems exist in nature inspires us to design biocompatible, biodegradable and biofunctional systems such as glycosaminoglycan mimicking peptide nanofibers, hybrid peptide/polymer networks, multivalent glyco-nanostructures, zero and one dimensional self-assembled nanostructures for catalysis, metal incorporation and bioimaging, mechanically stable amyloid inspired hydrogels, mussel adhesion inspired biointerfaces, gene and drug delivery agents; liposomes, peptide nanonetworks, oligo-peptide ensembles that are developed in our laboratory.



Nanoelectromechanical Systems (NEMS)

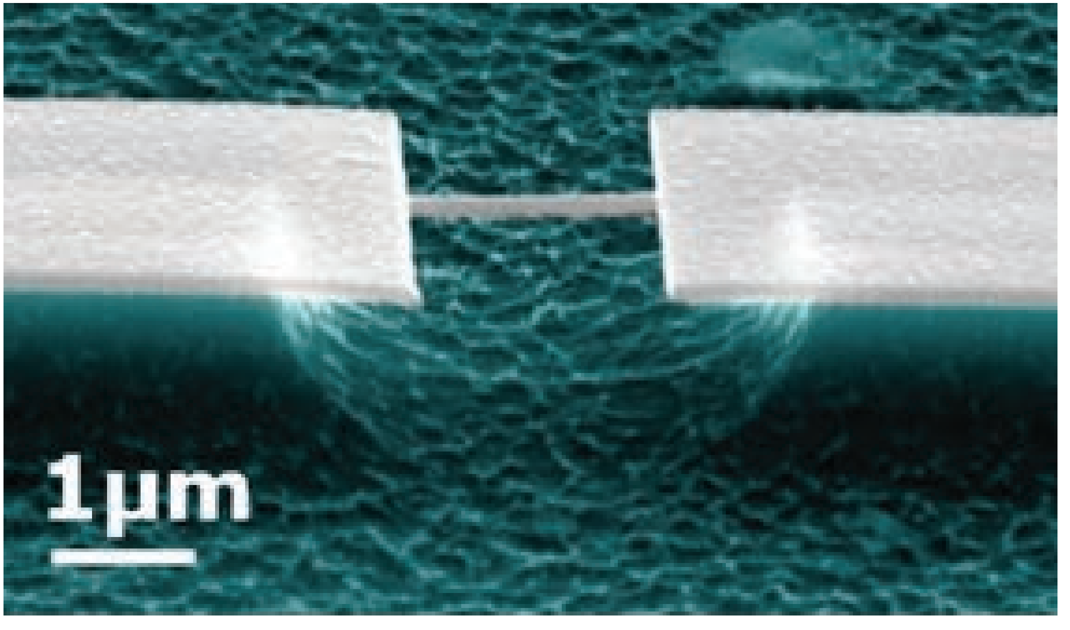
Dr. Selim Hanay

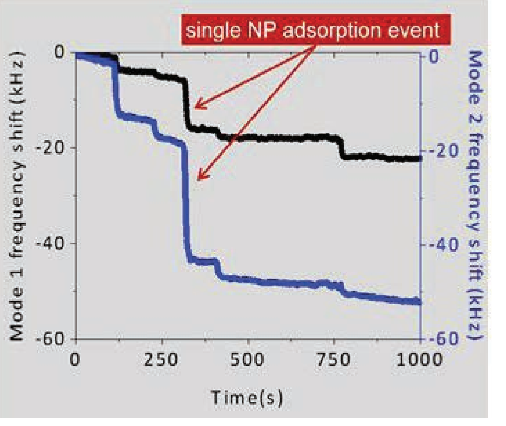
We are engineering ultra-small mechanical machines to develop novel sensor technologies for biological and environmental problems. Thanks to their miniscule size, these sensors are extremely sensitive to physical changes. We are developing NEMS-based mass spectrometry systems that enables chemical analysis at the single molecule level. These small systems have transformative potential for future applications in mobile, biochemical screening.

Nanoelectromechanical Systems (NEMS) are electronically controllable, submicron-scale mechanical devices used in fundamental studies as well as application oriented efforts. The field has been under active development since the early-1990s . NEMS technology has recently begun to transform from the domain of academic laboratories into the domain of microelectronic foundries, especially within the framework of Nanosystems Alliance. It is now possible to create thousands of devices in a single process run and use these devices in sensor experiments.

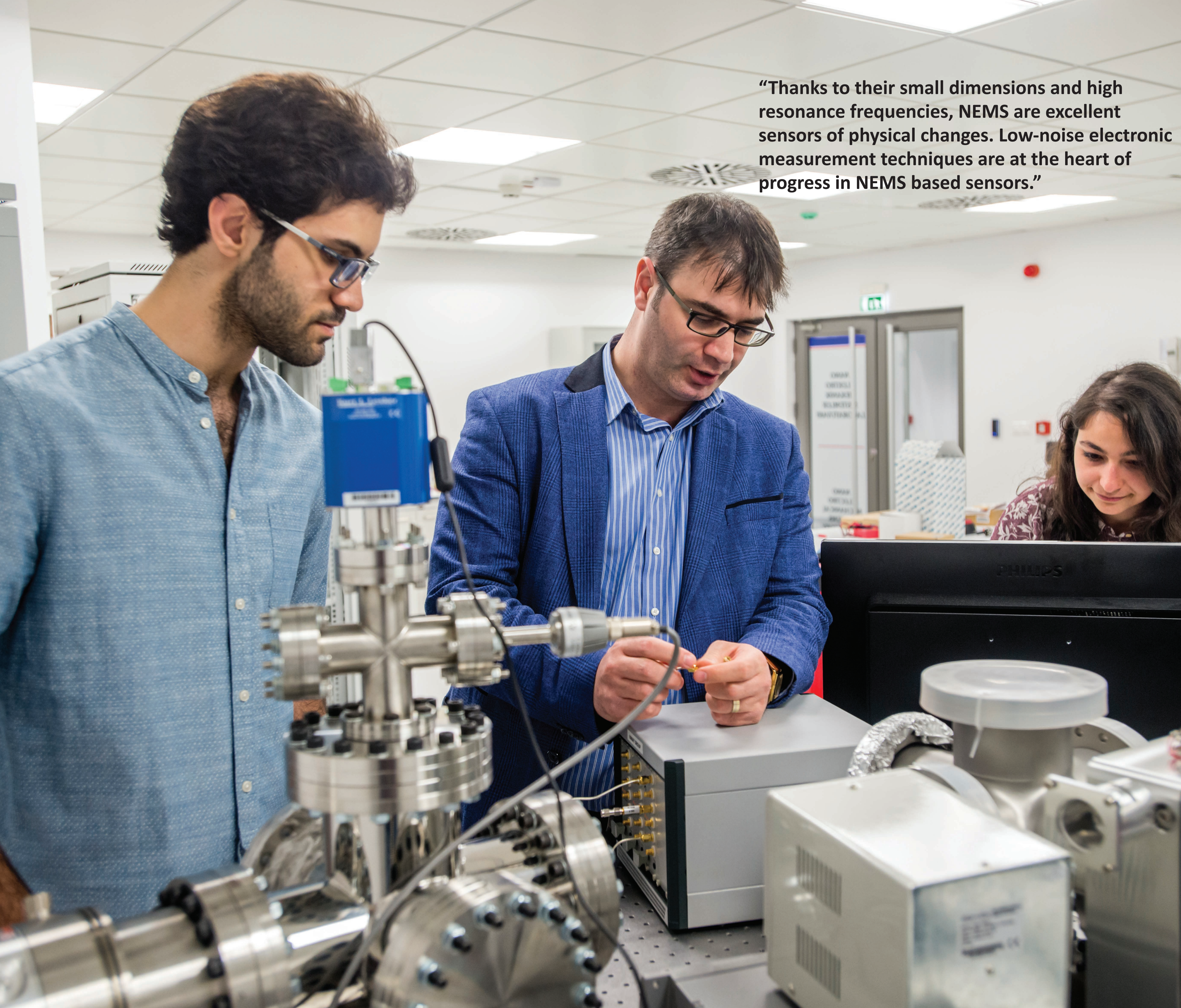
NEMS Mass Sensing and Mass Spectrometry

One application of NEMS technology is sensing extremely small masses. Mass sensitivity at the zeptogram (10^{-21} g) scale is possible with top-down fabricated NEMS devices. This level of sensitivity enables the mechanical weighing of single molecules which was demonstrated in 2012. The determination of molecular weight enables the identification of the molecule and opens up the possibility for chemical identification with NEMS devices.





The operation of NEMS as a mass spectrometer relies on the precise measurements of mechanical resonances. Each mechanical mode of a NEMS device has a specific resonance frequency determined by the effective stiffness and the effective mass of the particular mode. The resonance frequency is continuously monitored in experiments by a specialized electronic circuitry while sample molecules are introduced. Abrupt downward jumps in the resonance frequency are induced when an individual particle is adsorbed by the structure. From the measurement of mechanical frequency shifts, the mass of the added molecule can be determined.



“Thanks to their small dimensions and high resonance frequencies, NEMS are excellent sensors of physical changes. Low-noise electronic measurement techniques are at the heart of progress in NEMS based sensors.”

Dr. Ferdi Karadaş

Coordination Compounds for Hydrogen Economy

Hydrogen economy is one of the most promising candidates of alternative energy sources, which is of great importance due to limited sources of fossil based fuels and the increase in global energy demand. Two of the main challenges in hydrogen economy is water-oxidation and hydrogen storage.

Solid Adsorbents for H_2 Storage

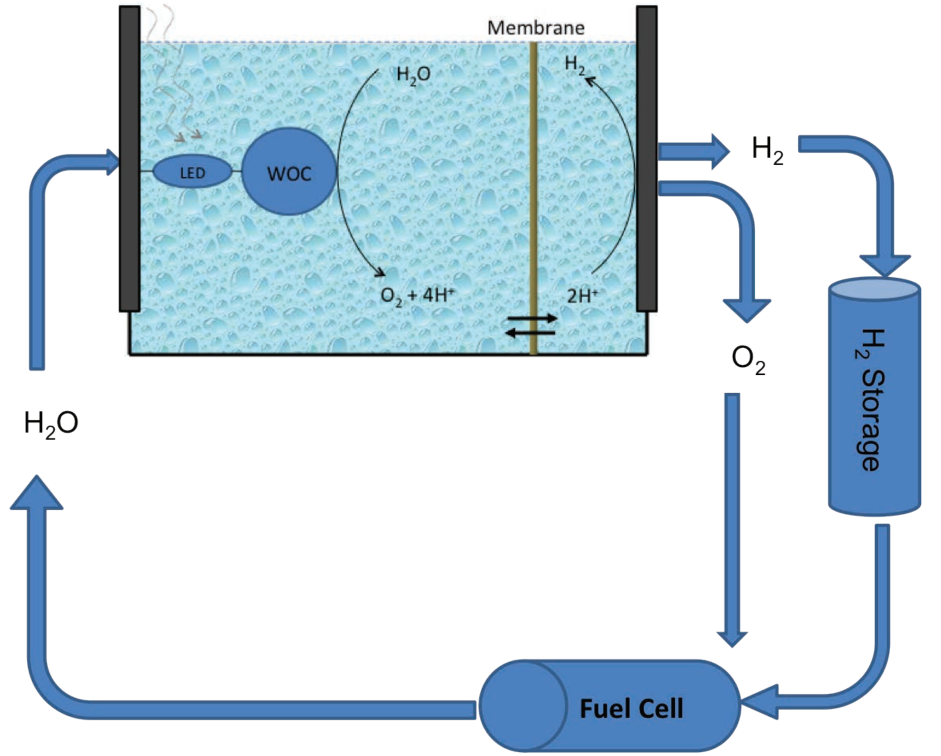
Solid adsorbents that could physically adsorb hydrogen are one of the most promising class of materials since they are robust at extreme conditions and their regeneration energy is negligible. Preparation and investigation of solid adsorbents that exhibit high performance at ambient conditions is the primary objective of our research group.

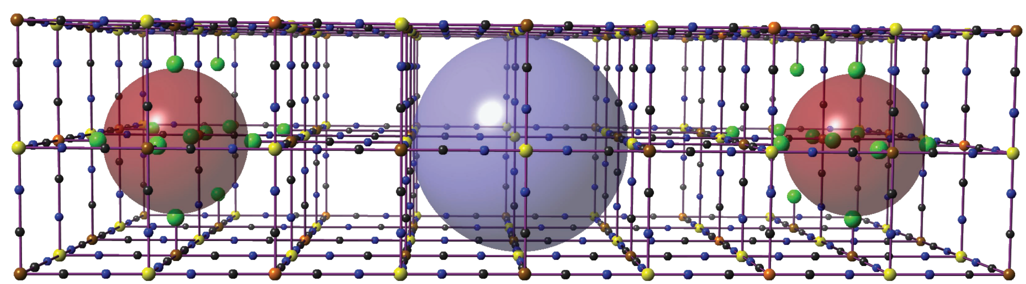
Coordination Compounds for Water-oxidation Catalysis – Artificial Photosynthesis

Water-oxidation catalysis is the most critical step in water-splitting since it is a four-electron process and requires a higher potential than hydrogen evolution step.

$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$ E = 0.82 V, at pH 7

The preparation of convenient and efficient catalysts that will function in the 'artificial photosynthesis' area is one of the objectives of our group.





Metal Cyanide Coordination Compounds
Red and purple spheres represent the vacancies inside the network.

“We are interested mainly in the synthesis and characterization of novel inorganic and organometallic coordination polymers and multinuclear molecular complexes.”

Dr. F. Ömer İlday

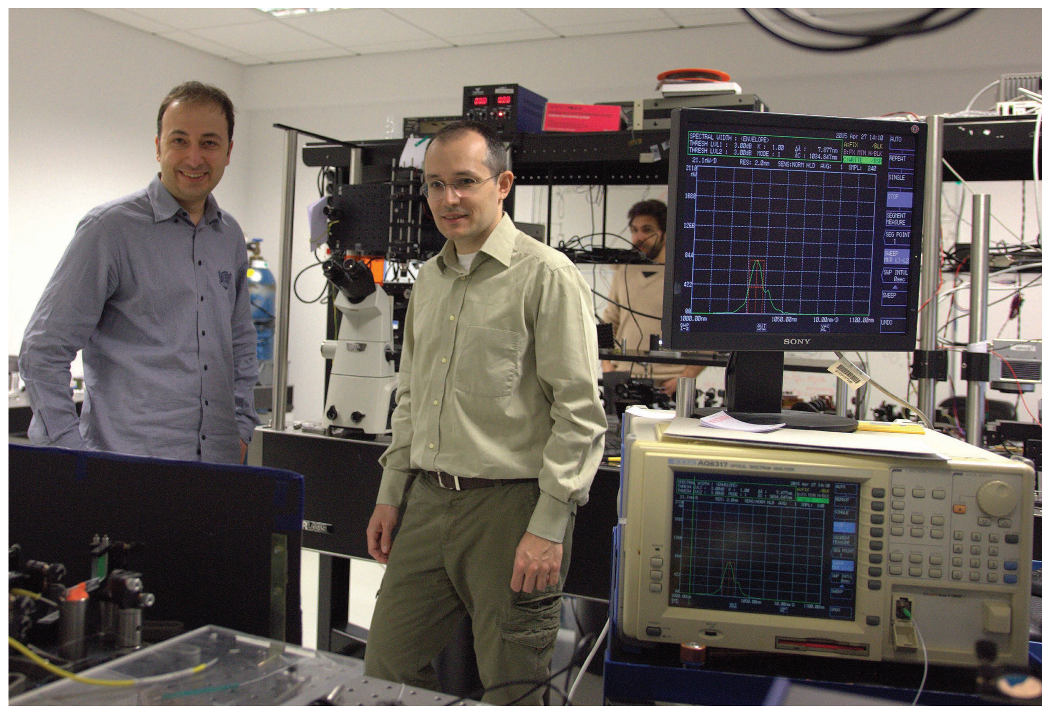
Laser-induced Fabrication of Self-organized Nanostructures

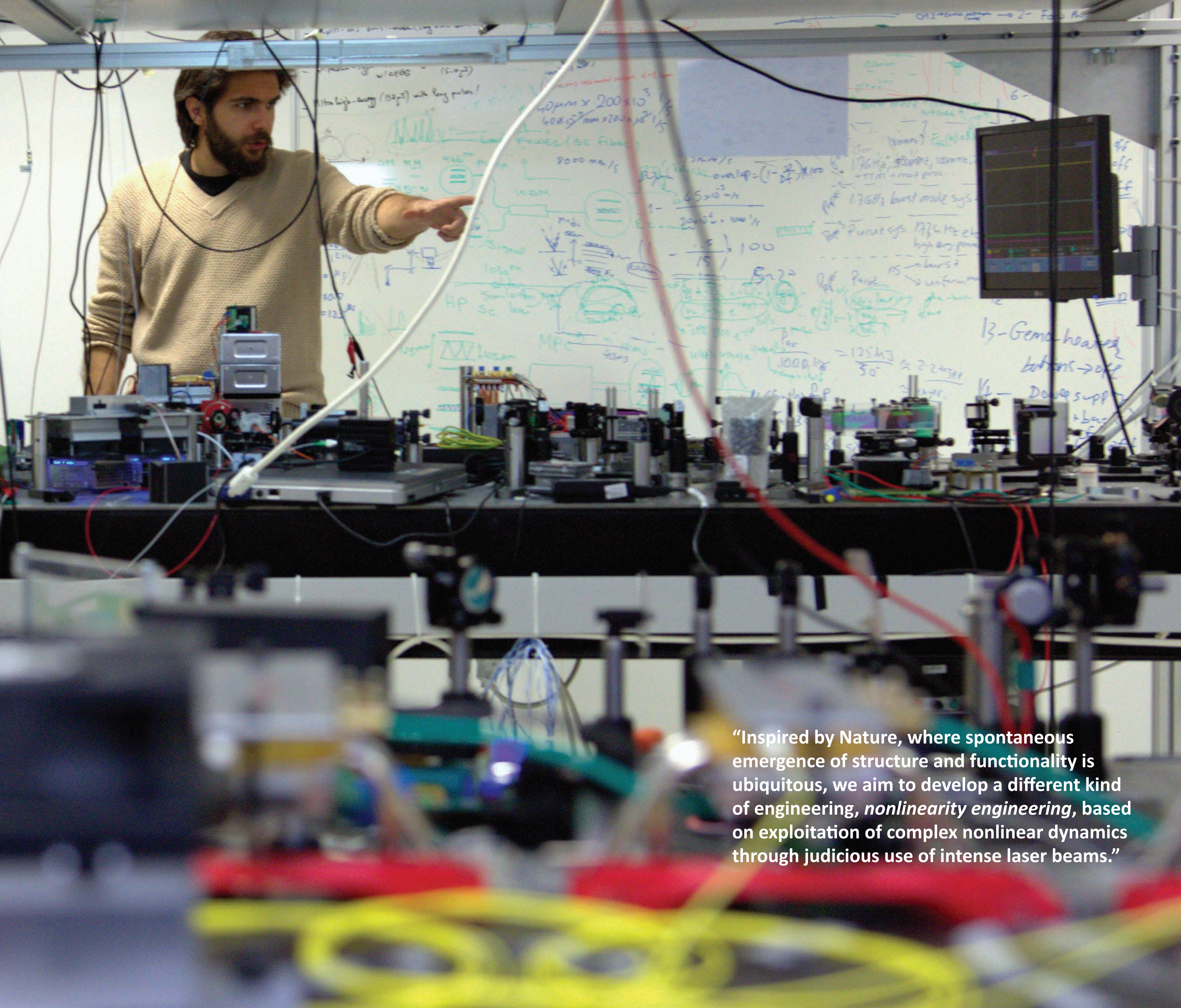
Control of matter via light has always fascinated mankind; not surprisingly, laser patterning of materials is as old as the history of the laser. We have recently demonstrated a technique, Nonlinear Laser Lithography (NLL), that allows laser-controlled self-organized formation of metal-oxide nanostructures with nanometer levels of uniformity over indefinitely large areas by simply scanning the laser beam over the surface. We now seek to vastly improve these capabilities through advanced control of the laser field and spatially selective introduction of reactive chemical species with plasma jets.

Everything in Nature is self-organized. Natural systems generate structure and functionality effortlessly from stochastic processes, often shaped by nonlinear feedback mechanisms. Our approach is inspired by such processes, which are ubiquitous in Nature, but rare in man-made technology. Intense coherent electromagnetic waves produced by a laser is a great tool for control. Plasma jets allow precise and spatially localized introduction of desired reactive chemical specifies onto surfaces. By combining these two powerful leverages, we are focussed on extending our control over the self-organized dynamics to fabricate a plethora of 2D patterns of a wide range of material compositions, eventually assembled layer by layer into the third dimension.

The primary motivation for this work stems from a desire to understand how to effectively control self-organized processes involved in laser-material interactions. The broader context is that, we believe, by exploiting nonlinear mechanisms inherently present in many physical systems, we can achieve amazing technological functionalities, which are difficult or impossible to achieve in strictly linear systems. Besides this fundamental motivation, various practical applications can be envisioned, building on the capability of NLL to work on flexible, non-flat, and even rough surfaces, consequently, technical materials. This is an effort funded by the ERC Consolidator Grant “Nonlinear Laser Lithography”.

Other research undertaken by the Ultrafast Optics and Lasers Laboratory (UFOLAB) concerns development of novel mode-locked laser oscillators, high-power ultrafast fiber lasers and applications of the lasers we develop to biomedicine and advanced laser material processing.





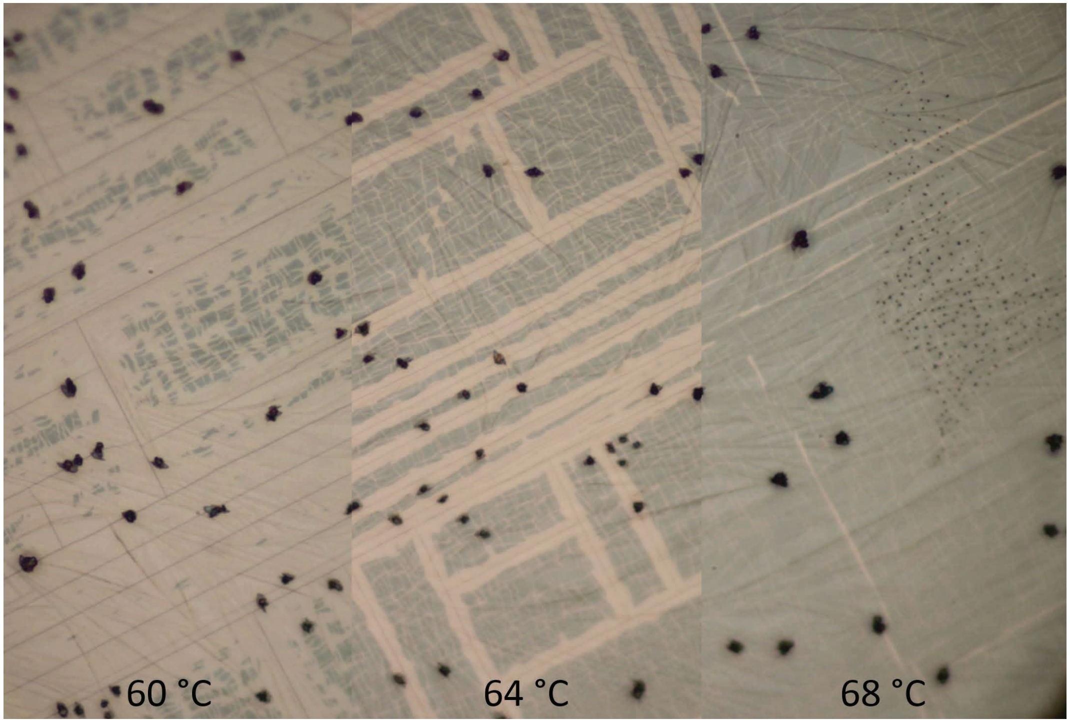
“Inspired by Nature, where spontaneous emergence of structure and functionality is ubiquitous, we aim to develop a different kind of engineering, *nonlinearity engineering*, based on exploitation of complex nonlinear dynamics through judicious use of intense laser beams.”


"At SCMLab we investigate the fundamental
properties of materials using optics and electronics
to find new physics and applications".

Dr. Serkan Kasırga

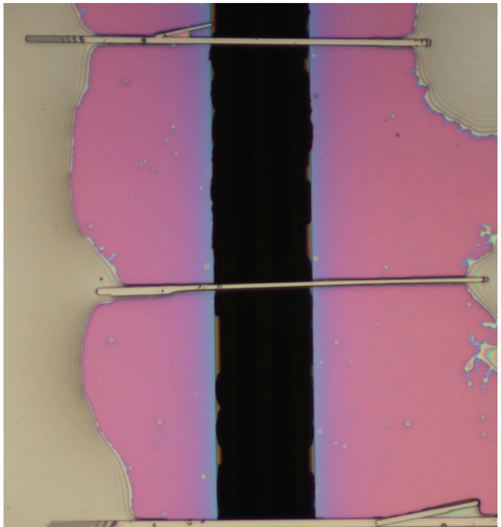
Strongly Correlated Materials Laboratory

Unlike the standard materials used in the semiconductor industry, degrees of freedom exist in strongly correlated materials that could significantly impact electronic and optoelectronic technology. Our research interests lie in understanding the phenomena arising from strong electronic correlations at nano-scales and employing these phenomena for novel applications.



Studying strongly correlations at nanoscales

When the interactions between electrons with other electrons and phonons in a material are comparable to the average kinetic energy of the electrons, single electron theories fail to capture the exotic phenomena observed.



30 nm thick nanobeams transferred across a 5 micron wide trench

Metal-insulator transition, high Tc superconductivity and giant magnetoresistance are just a few examples of the phenomena emerging from the strong correlations. Part of our research is focused on understanding the phenomena emerging from the strong correlations in materials using experimental methods and applying this practical understanding to technologically useful applications. Our research is especially focused on the metal-insulator transition of vanadium dioxide. We study nano crystals of VO_2 using optics and electronics to achieve applications in electronics and hydrogen related applications.

2D Materials

Peculiar properties of graphene have attracted waves of attention and this interest has spread to other layered materials. The reason is mainly due to possibility of applications in wide range of areas using peculiar electronic, spin, orbital and valley interactions of 2D layered material heterostructures. Strain in such materials plays an important role in material parameters such as conductivity, mobility, band gap, magnetization, valley effects etc. Using standard optical and electronic probing techniques we study the effects of strain on the properties of layered materials and purpose made heterostructure devices.

Dr. Coşkun Kocabaş

Laboratory of Quantum Optoelectronics

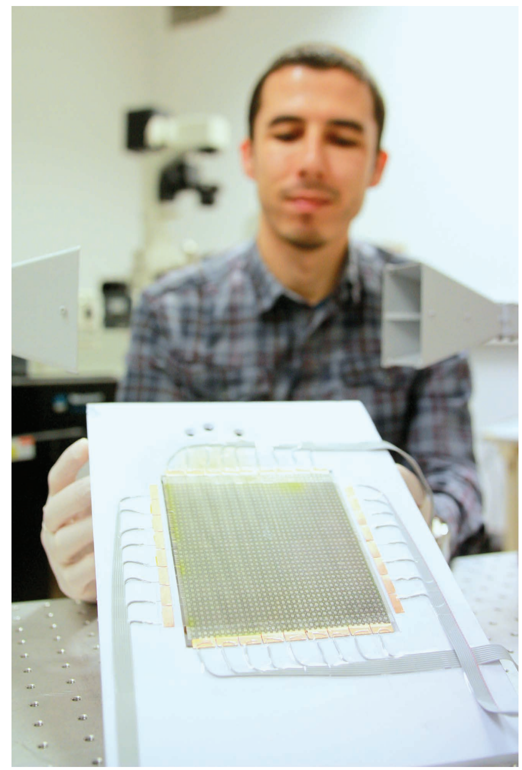
Our group is working on synthesis of new quantum materials and their integration in to electronic and photonic devices. Our long term goal is to understand and engineer electronic and optical responses of emerging quantum materials. Using these quantum materials we would like to develop multidisciplinary system-level approaches to build new integrated hybrid systems that yield novel functional devices. Our recent research is focused graphene based optoelectronic devices for tunable light-matter interaction in broad spectrum from visible to microwave frequencies.

Graphene-based adaptive camouflage

Radar-absorbing materials are used in stealth technologies for concealment of an object from radar detection. Resistive and/or magnetic composite materials are used to reduce the backscattered microwave signals. Inability to control electrical properties of these materials, however, hinders the realization of active camouflage systems. Our group is working on new approaches for adaptive camaoflage systems using large-area graphene electrodes. We developed active surfaces that enable electrical control of reflection, transmission and absorption of microwaves. Instead of tuning bulk material property, our strategy relies on electrostatic tuning of the charge density on an atomically thin electrode, which operates as a tunable metal in microwave frequencies. Notably, we report large-area adaptive radar-absorbing surfaces with tunable reflection suppression ratio up to 50 dB with operation voltages <5 V. Using the developed surfaces, we demonstrate various device architectures including pixelated and curved surfaces. Our results provide a significant step in realization of active camouflage systems in microwave frequencies.

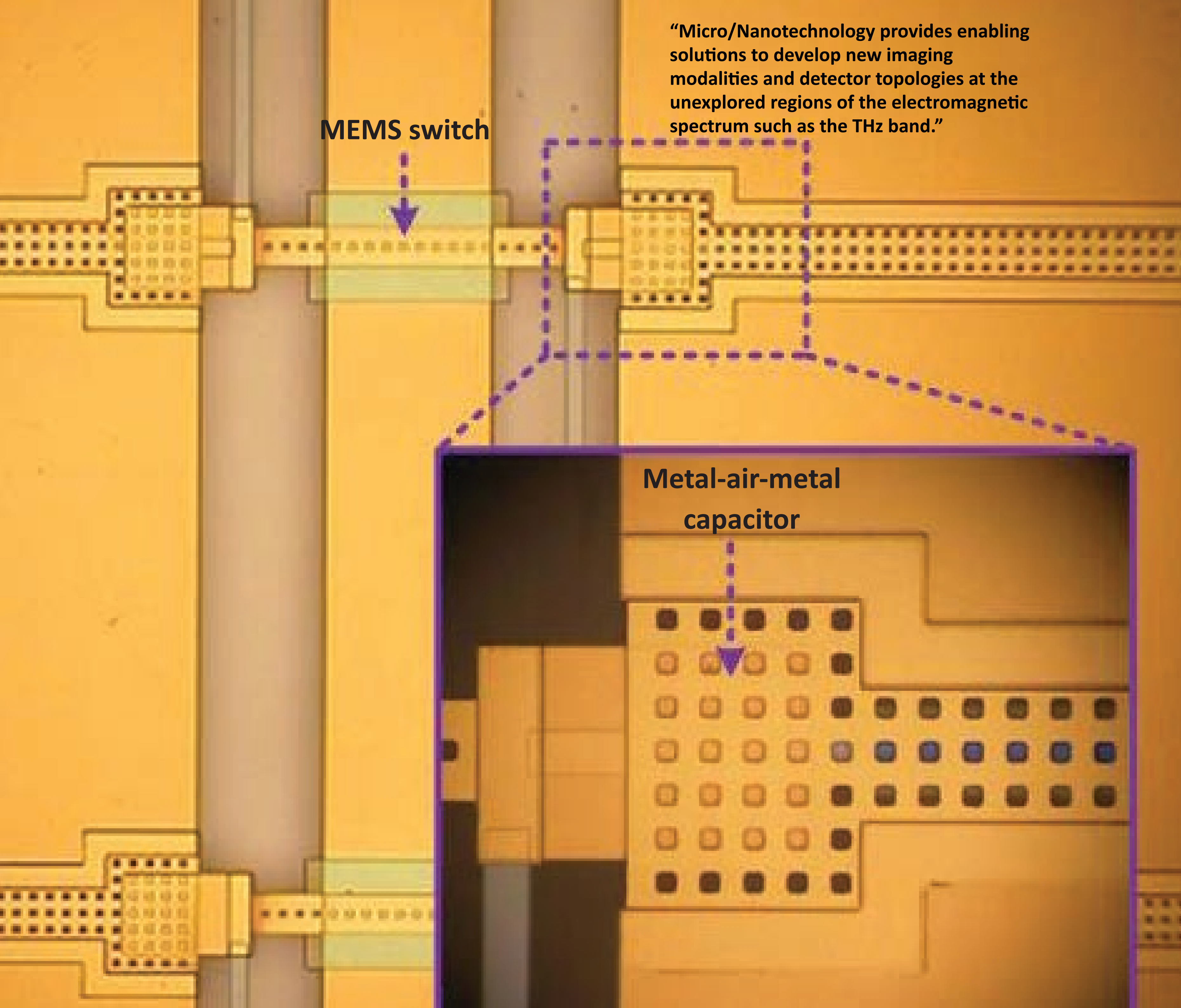
Graphene based optoelectronics in the visible

Graphene emerges as a viable material for optoelectronics because of its broad optical response and gate-tunable properties. For practical applications, however, single layer graphene has performance limits due to its small optical absorption defined by fundamental constants. We are working on a new class of flexible electrochromic devices using multilayer graphene (MLG) which simultaneously offers all key requirements for practical applications; high-contrast optical modulation over a broad spectrum, good electrical conductivity and mechanical flexibility. Our method relies on electro-modulation of interband transition of MLG via intercalation of ions into the graphene layers. The electrical and optical characterizations reveal the key features of the intercalation process which yields broadband optical modulation up to 55 per cent in the visible and near-infrared. We illustrate the promises of the method by fabricating reflective/transmissive electrochromic devices and multi-pixel display devices. Simplicity of the device architecture and its compatibility with the roll-to-roll fabrication processes, would find wide range of applications including smart windows and display devices. We anticipate that this work will provide a significant step in realization of graphene based optoelectronics.



“Emerging quantum materials open up exciting possibilities for their fascinating optoelectronic properties.”

“Micro/Nanotechnology provides enabling solutions to develop new imaging modalities and detector topologies at the unexplored regions of the electromagnetic spectrum such as the THz band.”



Dr. Kağan Topallı

Reconfigurable Micro/Nano Systems for EM Waves

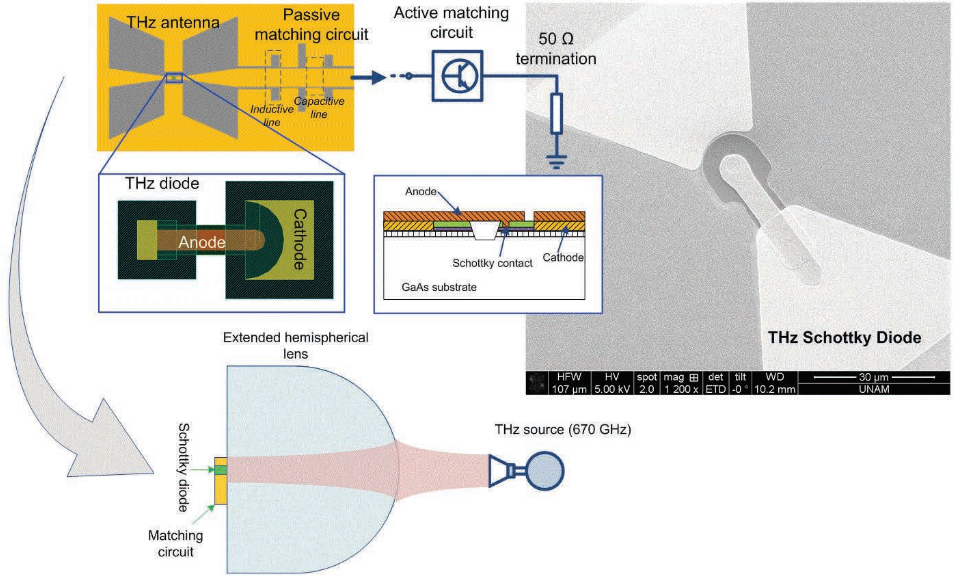
We are working on developing reconfigurable antennas and microwave devices using micro/nanotechnology as an enabling tool from microwaves to terahertz frequencies. The research involves interdisciplinary research activities related to electromagnetic waves and micro/nanofabrication. In particular, we aim at providing solutions with unprecedented functionalities at telecommunications and sensing applications.

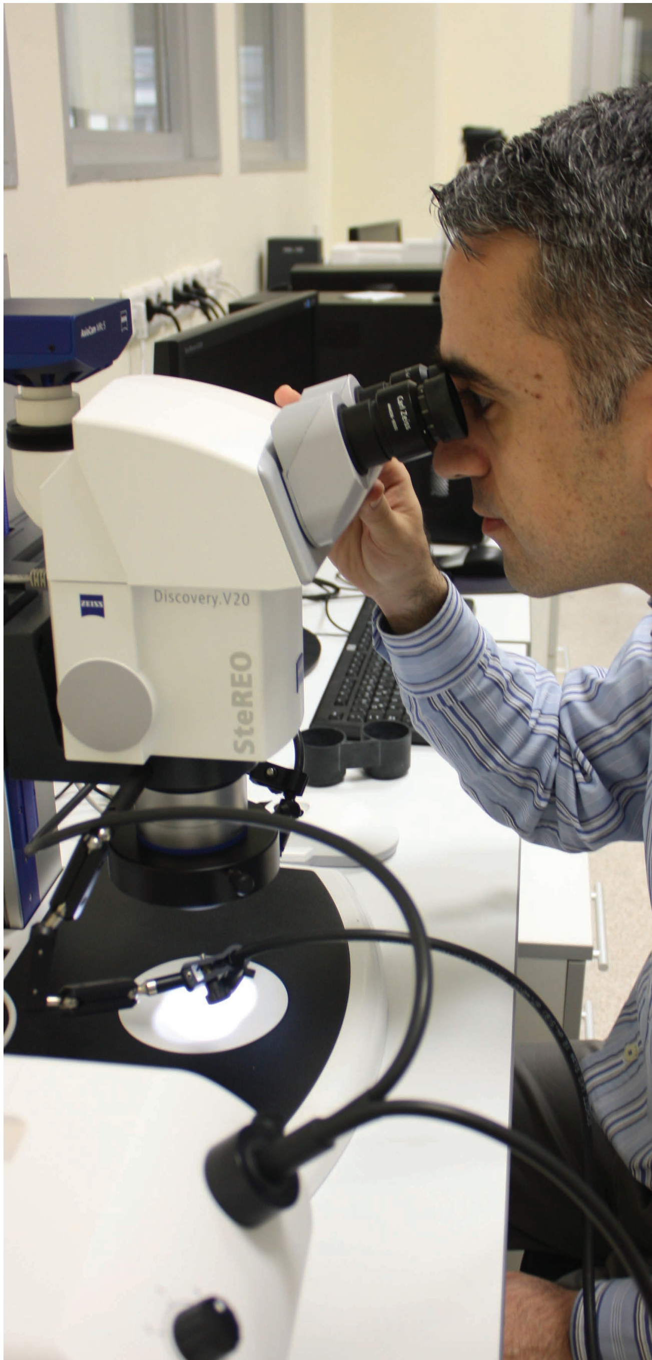
THz detection and imaging:

Sensors utilizing the THz band, which is defined as the band between 100 GHz and 3 THz of the electromagnetic spectrum, are emerging as viable imaging tools for detection and classification of various medical anomalies, such as tumorous tissues and dental caries, as well as various security and military applications. For example, a new, high sensitivity THz camera could enable visibility in brown-out conditions, such as during sand storms and/or rotorcraft take-off and landing in desert environments. THz imaging is unique because it is a non-harmful imaging source that can simultaneously extract extensive spectroscopic information from the scene. THz band can also provide a solution to develop new communication techniques for indoor wireless communication achieving Tb/s data rates for file transfer.

Reconfigurable antennas and antenna arrays using RF MEMS technology:

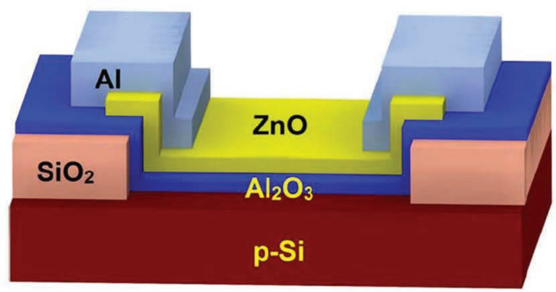
Over the past decade, RF microelectromechanical systems (MEMS) technology has offered solutions for the implementation of novel components and systems. This technology promises to solve many limitations of other technologies (pin diodes and FET switches), especially for high-frequency applications. RF MEMS enables the realization of reconfigurable components such as switches, capacitors, and phase shifters with low insertion loss, low power consumption, and high linearity compared to the conventional techniques.

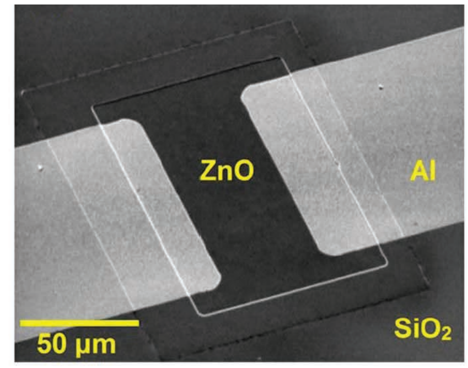




Integrated Devices and Sensors for Functional & Smart Systems

A diverse team with strong international ties: Okyay Group, composed of an international team of 25+ research students, engineers, and postdoctoral researchers, is globally recognized for groundbreaking work on semiconductor devices and sensors. Okyay Group is collaborating with national and international research groups, by joint projects and scientific publications as well as student exchange.





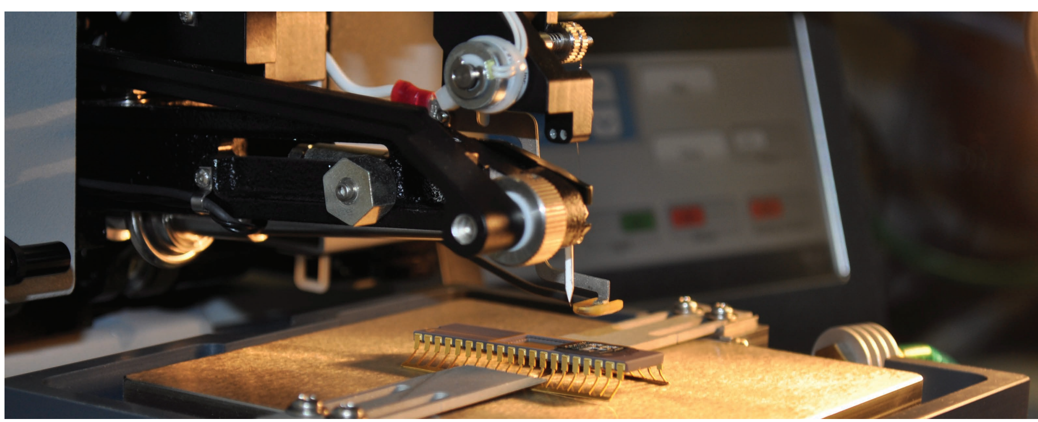
Cutting edge research

Research topics include the development and demonstration of innovative nanophotonic devices based on smart materials, atomic layer deposited metal oxide and III-nitride layers and photodetector and transistor devices, novel memory devices, perovskite and nanomaterials for next generation solar cells nanocrystal, metal nanoparticle and nanowire embedded nanodevices, high-performance RF and optoelectronic sensors. To date in the Okyay Group at Bilkent, together with his research students and colleagues, resistive switching assisted active tunable photonic structures; dynamic control and electrically tunable optical properties of thin film semiconductor layers for smart systems; plasma-assisted atomic layer deposition of crystalline GaN, and transistor fabrication process with the world's lowest process temperature; semiconductor-less photovoltaic devices based on plasmon-coupled hot electron collection; all-ALD memory devices with substantially enhanced performance; record-breaking high TCR (temperature coefficient of resistance) materials have been successfully demonstrated. Dr. Okyay's PhD research focused on the development of novel ultra-compact optoelectronic switching devices for high-density optical interconnections on chip scale; his doctoral work is recognized for producing the world's first chip-scale light-to-latch concept. He also contributed to the realization of the world's smallest CMOS-compatible plasmon-coupled photodetector.

Success stories and commercialization

Okyay Group members' receive prestigious awards for their significant contribution to scientific community including IEEE and SPIE fellowships. The Group is currently funded by 10+ international and national research projects.

In 2014, our group's work has been the cover story in four prestigious scientific journals. Various works of Okyay Group are highlighted in prestigious scientific journals such as Nature Photonics. Not only we aim to push the frontier of science and technology, but also we maintain a keen eye on the commercialization of our research. A spin-off company from our group is working on next generation sensors while a recent one is manufacturing Atomic Layer Deposition equipment. In 2014, the first functional ALD tool is demonstrated and the company started receiving orders for this tool.



“Not only we aim to push the frontier of science and technology, but also we maintain a keen eye on the commercialization of our research.”

"We focus on the development of newly design pulsed and CW laser sources delivering unprecedented performance in term of the compactness, low noise, energy and power levels as versatile tools for scientific and industrial applications."

Dr. Bülend Ortaç

Laser Science & Technology

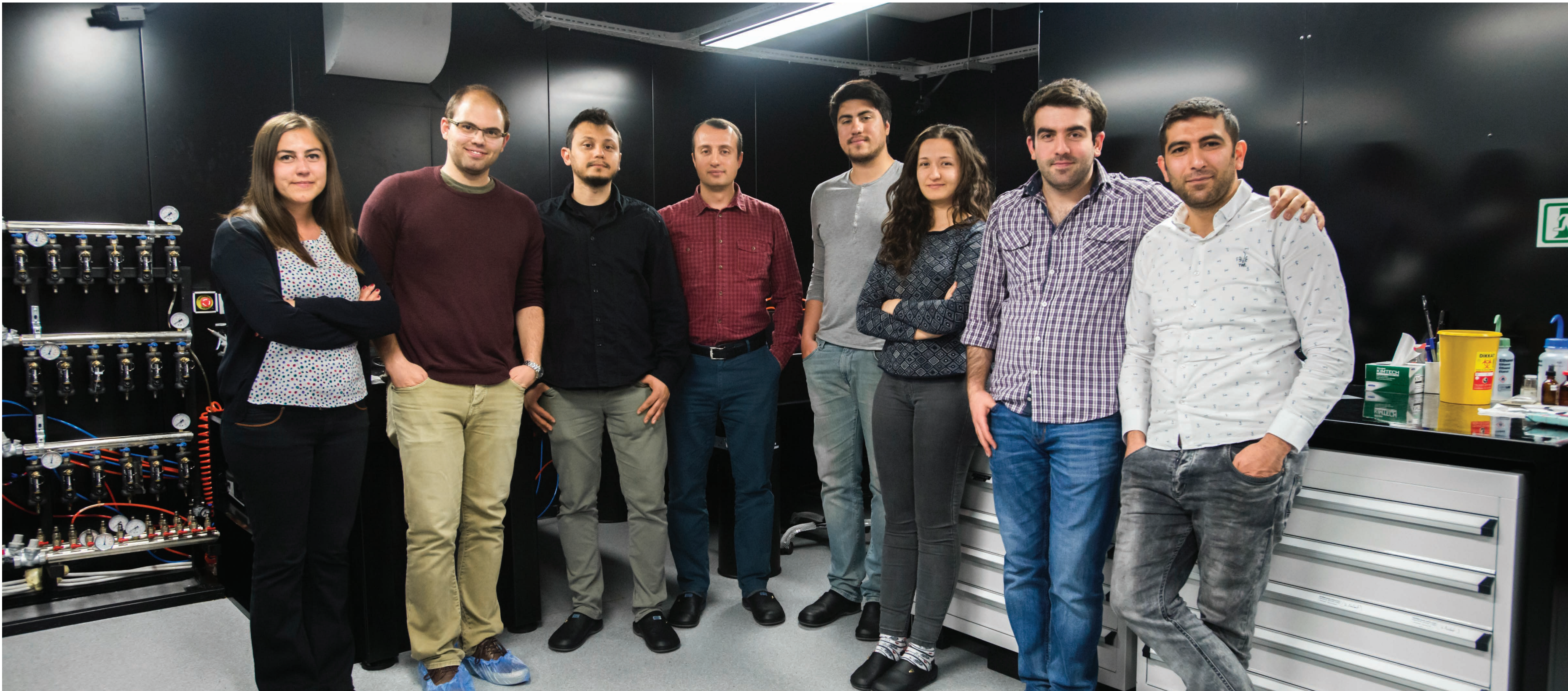
Our research activities are concentrated in the fields of laser science and technology. We design and develop powerful wide-range fiber-based laser systems. We focus on the development of newly design and original pulsed and CW laser sources delivering unprecedented performance in term of the compactness and power levels as versatile tools for scientific and industrial applications. The ongoing research activities include investigations of laser interaction with various solid and biological materials.

High-power laser lights, such as industrial, defense and health care has become extremely important for many applications. In fiber laser systems, the new generation fiber optic cables are used. Fiber laser systems, with the ease of use provided by the field, are preferred especially for high-power laser systems because of reduced heating problem, higher productivity level for increased rate of absorption of light pumped, and high-quality optical cavity laser light produced during the use and optimization of the system.

In terms of our fiber laser research, we are mainly focusing on the design and development of powerful pulsed and CW laser sources for different scientific and industrial applications. We also perform theoretical investigations on our laser systems for better understanding and control of system parameters. Those powerful laser systems can be used in different industrial areas including the defense industry.

Besides those powerful fiber laser systems, we are also working on the design and development of modulated medical lasers and medical optical fibers for different applications. We have already developed a laser system for the endovenous laser ablation operations. We are currently working on a retinal laser system.

We are working on the generation of pure and stable nanoparticles through laser ablation in liquids and modification of them according to the intended use. The nanoparticle research continues with different collaborations and the research subjects ranges from sensor development to biological interactions.



“Human family trees are instrumental in solving the mysteries of the genome.”

Dr. Tayfun Özçelik

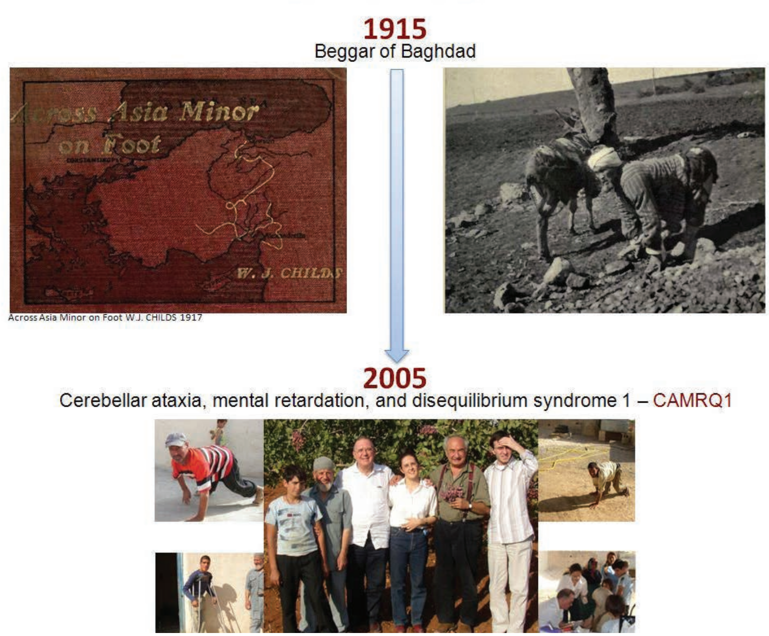
Human Genetics and Genomics

The focus of research in our laboratory is characterization of mutations and mechanisms that lead to genetic disorders in humans. Our journey into the genome began nearly 25 years ago by determining the chromosomal localization of cloned genes in human and mouse to identify the molecular basis of inherited diseases. Also, we conducted classic linkage studies in large multigenerational families. Utilizing these approaches, we identified genes associated with Prader Will Syndrome, Charchot-Marie-Tooth disease type 1A, hereditary MLH1 deficiency and several different types of disequilibrium syndrome (Uner Tan syndrome,CAMRQ).

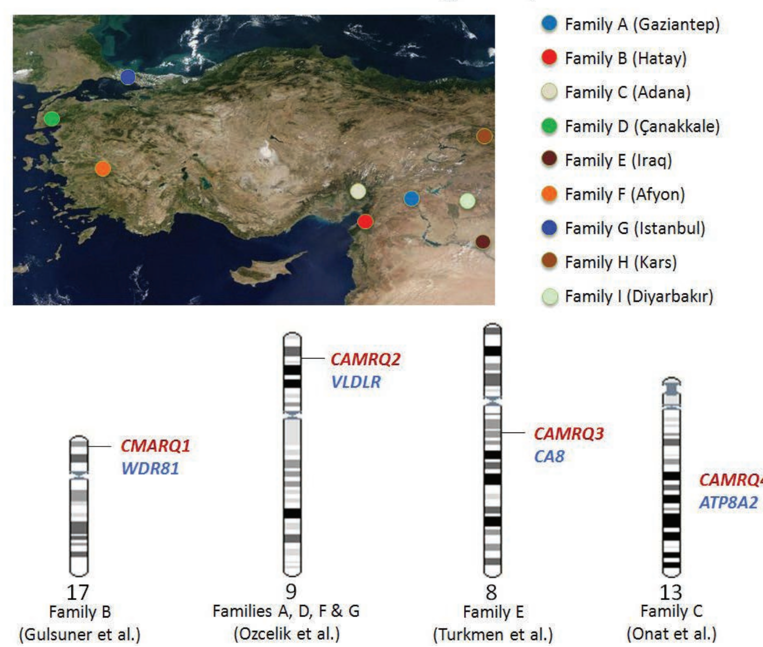
At present, we extend our studies to complex phenotypes in humans for the identification of genes associated with obesity, extreme leanness, polycystic ovarian syndrome and essential tremors. We resort to next-generation sequencing and bioinformatics approaches to explore and annotate the human genome. In collaboration with members of the neuroscience community at Bilkent as well as scientists at Rockefeller University, Yale University and University of Washington, we design further experiments to determine the expression patterns, regulation, and function of these genes. Our ultimate goal is to understand pathophysiological processes in disease states, and to devise diagnostic tests and rational treatment strategies.

In 2014, our group continued to study complex phenotypes in humans including obesity and essential tremors. Together with Dr. Tekinay from UNAM, we identified a gene which causes essential tremor and Parkinson disease. In an independent line of research, our group studies the rate of early post-zygotic mutations in humans and uncovered that de novo variation could substantially contribute to the pathogenies of humandiseases.

Quadrupedal gait



Genetic heterogeneity



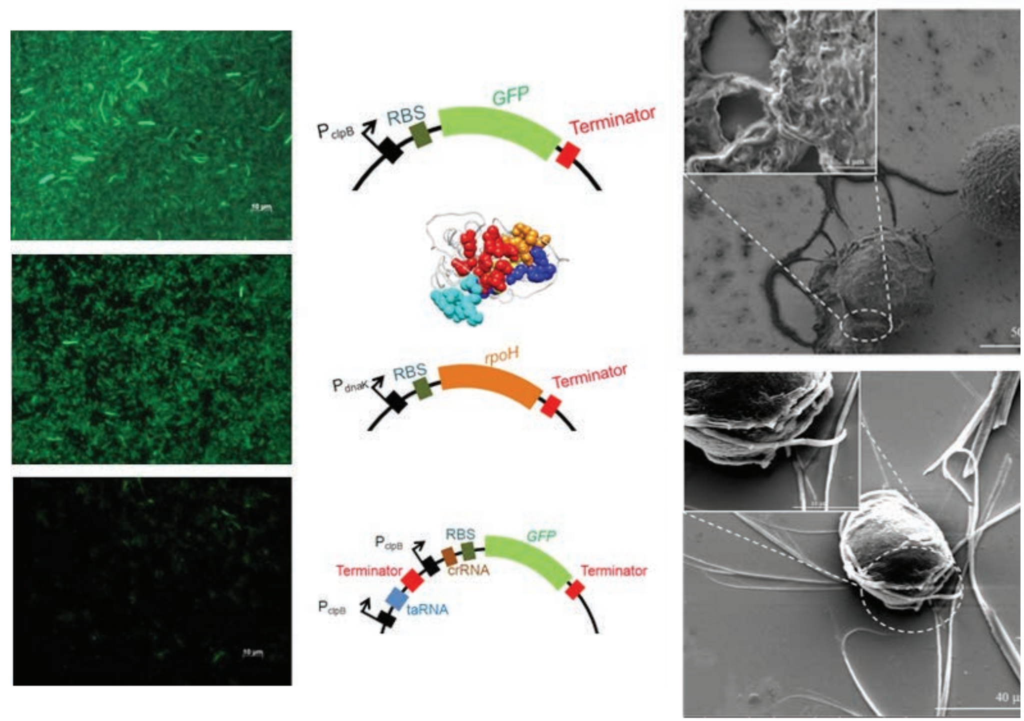
Dr. Urartu Özgür Şafak Şeker

Synthetic Biosystems and Bioengineering

Synthetic Biology is an emerging engineering discipline which focuses on designing and implementation genetic devices inspired by electrical engineering and computer science. We are interested in designing and implementation of genetic circuits: to build whole cell sensors, to create novel biocatalysis systems, and to produce nano/biomaterials with engineered functionality. We are also interested in designing and utilization synthetic genetic regulation systems and elements.

Synthetic biology is changing our view for designing of new organisms with synthetic gene expression and its synthetic regulations for a desired functionality. Synthetic biology is aiming to engineer both native metabolic pathways and exploring novel pathways in an organism for advanced well controlled functionality. Systems biology catalogs novel parts, metabolic networks, and regulatory strategies from various organisms these are being exploited by synthetic biology. In synthetic biology applications each functional genetic part was considered as a component in a circuit. Synthetic circuits are formed using genes/proteins and genetic regulation elements. To form a genetic circuit well characterized biological parts from various organism can be exploited. Some of these parts are nucleic acids, genetic regulatory elements and proteins. Combining these biological parts logic gates, memory units, biological switches (e.g. toggle switches), biological oscillator, biological devices those can make computations can be formed. A genetic language to program cellular functions can be achieved as well. All the biological devices under the control of a cellular program can achieve highly complicated tasks for a certain function.

Currently we are designing genetic circuits for nanotechnological, biomedical and biotechnological applications. We are utilizing biomaterial synthesis genes from various organism to create a synthetic circuit for single pot nanomaterial/biomaterial synthesis and functionalization. Synthetic whole cell sensors for biomedical, food and environmental monitoring is also another topic we are focused on. We are building gene circuits to mimic the biological conductivity to integrate with lab-in-a-cell systems (an integrated cellular platform with many sensory gene circuits) those can communicate with electronic interfaces through engineered conductive biofilms. Additionally we are exploring synthetic biology tools to build electro-genetic and opto-genetic systems for biotechnological and biomedical applications.



“Synthetic Biosystems Laboratory has sucessfull showed to develop new materials using biofilm proteins by employing synthetic genetic circuits. In its diverse research interest SBL is currently developing whole cell sensors to monitor nanomaterial biocompatibility, and to carry biomedical tests to monitor disease conditions”

Dr. Ayse B. Tekinay's group works on understanding the molecular mechanisms behind tissue degeneration and utilization of this information for regenerating the damaged tissues using nanotechnology. In 2014, our group published several papers in prestigious scientific journals including PNAS, Biomacromolecules, and Acta Biomaterialia.

Nanobiotechnology

Dr. Ayşe Begüm Tekinay

Dr. Tekinay's group works on utilization of molecular biology and nanotechnology in understanding cell-extracellular matrix interactions. These interactions are crucial for determination of cell fate not only during development but also during regeneration of tissues and wound healing. Understanding these interactions in a comprehensive manner will enable using this knowledge for regenerative medicine and drug delivery applications.

Investigation of Molecular Mechanisms Behind Tissue Degeneration

Inherited human degenerative diseases provide an invaluable opportunity for identification of novel targets for regenerative approaches. Thus, one of our main research subjects is investigation of molecular and genetic mechanisms that are involved in these degenerative diseases to gain more understanding about their pathophysiology. We are particularly interested in neurodegenerative movement disorders including essential tremor and Parkinson's disease.

In addition, we are also working on investigation of molecular interactions between cells and their extracellular matrix, since the interactions are crucial for determination of cell fate not only during development but also during regeneration of tissues and wound healing. Understanding these interactions in a comprehensive manner will enable using this knowledge for regenerative medicine and drug delivery applications. However, since biochemical components and mechanical properties of natural extracellular matrix are highly complex and tightly regulated, we use simpler systems with selected nanosized components that form controlled platforms for studying cell behavior. Simpler synthetic systems that can mimic the function of these components enables detailed molecular characterization of these elements.

Synthetic Platforms for Regenerative Medicine and Drug Delivery

Since prevalence of degenerative diseases increases as the population ages, development of regenerative therapies is crucial. We use the knowledge that is gathered through analysis of molecular interactions between cells and extracellular matrix for developing novel synthetic platforms that can guide tissue regeneration in degenerative diseases and accidents. These systems alter stem cell fates and facilitate cell recruitment to damaged sites in order to assist and accelerate the process of natural healing. We also use the natural interactions between extracellular matrix components and specific cell types for developing nanosized drug delivery systems by which a therapeutic molecule can be delivered selectively to its target, hence increasing drug efficacy, reducing effective doses and minimizing toxic effects. Our group studies a wide array of drug vectors, including nanofibers, nanospheres, liposomes and SPIONs.

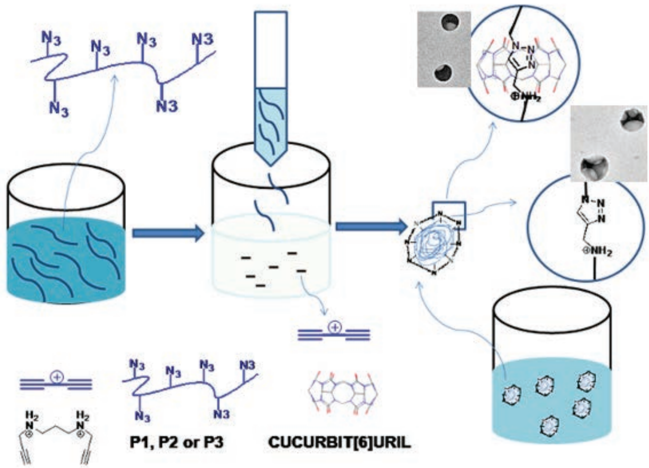
Dr. Dönüş Tuncel

Functional Organic Materials for Advanced Applications

The research in our group combines synthetic organic, supramolecular and polymer chemistry to prepare functional materials which have potential applications in the use of polymeric opto-electronic devices (LEDs, solid state lighting and photovoltaic devices), chemo- and bio-sensors, molecular switches. We are also interested in the design and synthesis of nanoparticles and nanocapsules based on light-emitting polymers for biomedical applications such as live cell imaging and theranostic nanomedicine. Here are some examples to the works carried out in our lab:

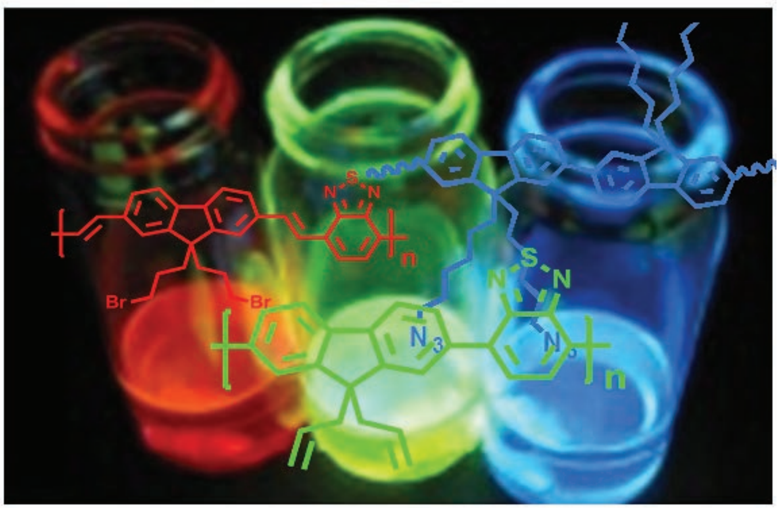
Cross-linked patchy fluorescent conjugated polymer nanoparticles synthesized by click reactions

Conjugated polymers converted into water-dispersible shape-persistent nanoparticles can be used in nanophotonics and bimedical applications.

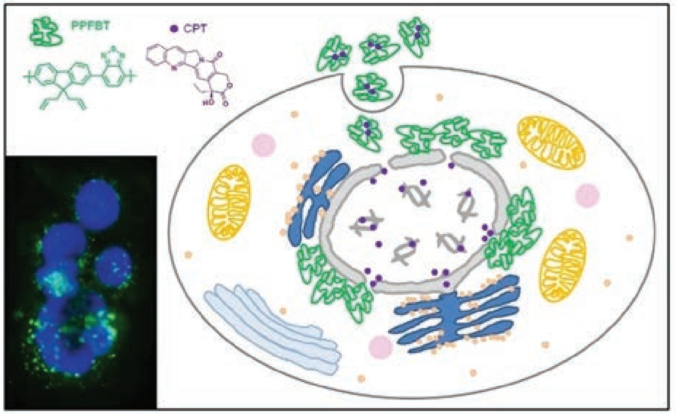


Light emitting conjugated polymers

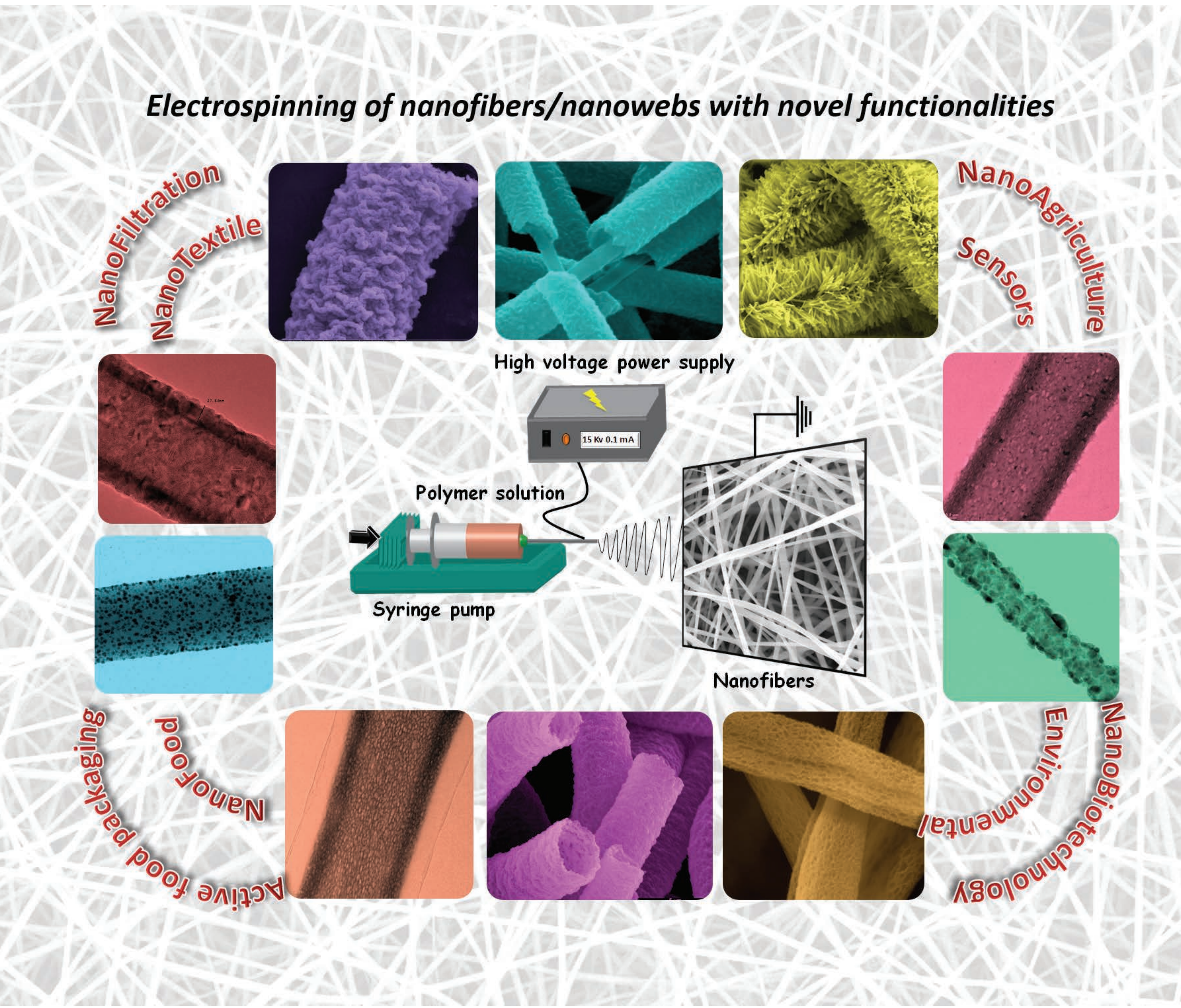
Blue, green and red emitting conjugated polymers which contain a variety of funtional groups are synthesized and their applications are exploited in the areas of optoelectronics and chemo and biosensing.



Dual functionality of conjugated polymer nanoparticles as an anticancer drug carrier and a fluorescent probe for cell imaging



“Conjugated polymers synthesized in our lab are converted into nanoparticles and loaded with anti-cancer drugs for controlled drug delivery and cell-imaging.”

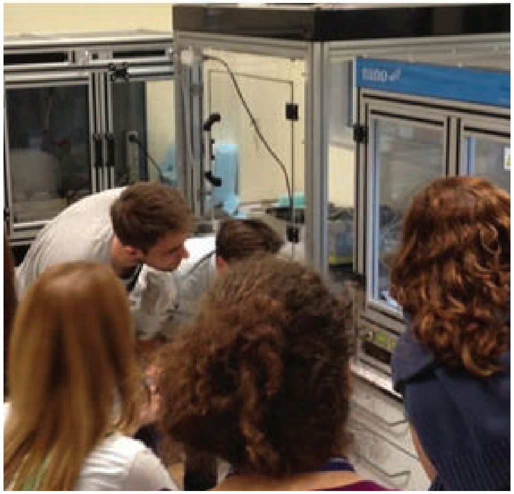


Electrospinning of nanofibers/nanowebs with novel functionalities
NanoFiltration
NanoTextile
NanoAgriculture
Sensors
High voltage power supply
15 Kv 0.1 mA
Polymer solution
Syringe pump
Nanofibers
NanoFood
Active food packaging
Environmental
NanoBiotechnology

Dr. Tamer Uyar

Functional Nanofibers via Electrospinning

Electrospinning is as a versatile and cost-effective technique for producing functional nanofibers from various polymers, blends, composites, ceramics, etc. Uyar Research Group have a main focus on electrospinning of nanofibers/nanowebs with novel functionalities for potential applications in Environmental (molecular filters, water purification, waste treatment, heavy metals removal, air filtration, VOCs removal), Textiles (antibacterial nanofibrous medical textiles, protective layer), NanoBiotechnology (wound dressing, controlled/sustained release systems), Food and active food packaging (delivery and stabilization of food additives; essential oils, antioxidants, antibacterials), Sensors (heavy metal sensors, explosive sensors, biosensors), Agriculture (nanofertilizer, seed/plant protection, controlled delivery of pesticides) and Nanocomposites (high performance nanofibrous materials).



In 2015, our group has published numerous publications in high impact journals including Chem Comm (Cover article), Scientific Reports, ACS Applied Materials & Interfaces, Journal of Materials Chemistry C, Applied Catalysis B: Environmental, RSC Advances, etc.

The research that we have performed in 2015 can be summurized in the following sub-topics;

- Fluorescent and Flexible Electrospun Nanofibrous Membrane for Sensing of Heavy Metals and TNT

- Bacteria Immobilized Reusable Electrospun Nanofibrous Webs for Water Treatment

- Core-Shell and Hollow Nanofibers by Electrospinning and Atomic Layer Deposition (ALD)

- Molecular Filters Based on Cyclodextrin Functionalized Electrospun Nanofibers

-Cyclodextrin Functionalized Electrospun Nanofibersfor Controlled Drug Release

Besides research, our group is very active training young researchers in the field electrospinning. We have organized an International Training School on Electrospinning of Nanofibers supported by COST Action MP1206 and UNAM, Bilkent University on 10-12 June 2015. Nearly 75 participants from 17 countries consists of experts, postdoctoral fellows and PhD students were participated in this training school.

Dr. Giovanni Volpe

Soft Matter, Optical Tweezers and Complex Systems

Our research focuses are primarily on statistical physics, soft matter, optical manipulation, and stochastic phenomena. We are interested in both experimental and theoretical aspects. We have also been active in plasmonics, Raman spectroscopy, biophotonics, cylindrical vector beams, and fiber optics.

Nanoscience and nanotechnology are in the process of revolutionizing the way we live and do science. Micro- and nanodevices herald a new era with unprecedented possibilities in sensing and information processing at the nanoscale. Perhaps more importantly, with the development of nanotechnology comes the hope of greatly reducing the need for prime materials and manufacturing, thus leading to a much cleaner post-industrial society. In the context of this drive towards the nanoscale, the specific aim of the soft matter lab is to harness nanoscopic forces and active matter at mesoscopic and nanoscopic length-scales in order to gain a better understanding of their fundamental properties and to explore high-impact applications.

Optical tweezers

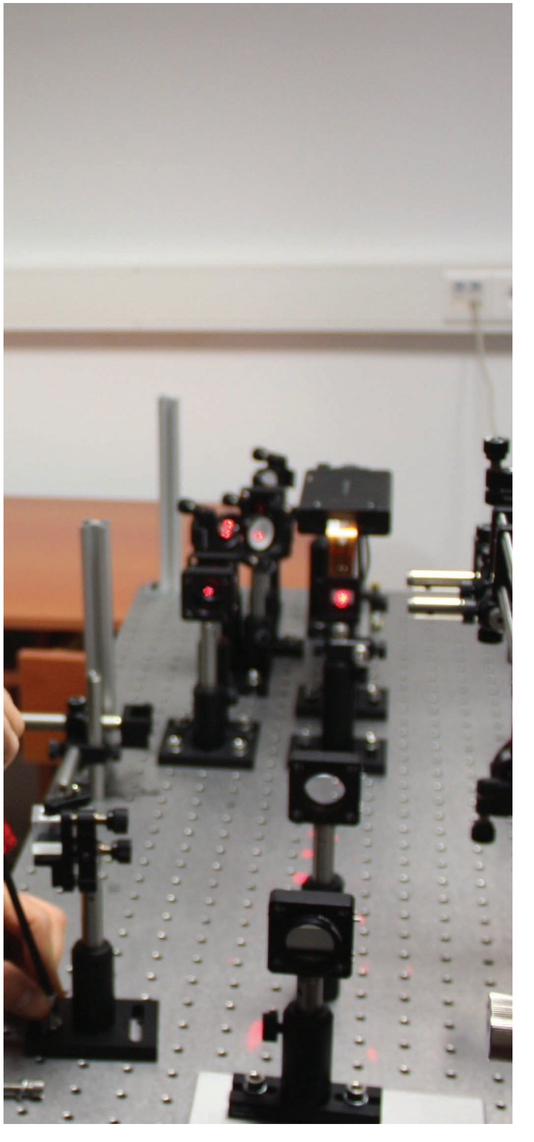
An optical tweezers is generated by a highly-focused laser beam and is capable of trapping and manipulating microscopic particles, such as cells, organelles and molecules. We are developing the optical tweezers technique so that it can explore new ranges of applications towards the nanoscale.

Measurement of nanoscopic forces

The ineluctable presence of thermal noise alters the measurement of forces acting on microscopic and nanoscopic objects, such as biomolecules and nanodevices. Our results demonstrate that the force-measurement process is prone to artifacts if the noise is not correctly taken into account. Our results are intimately connected to the long-standing issue of the interpretation of multiplicative noise in stochastic differential equations.

Active matter

Differently from passive Brownian particles, active Brownian particles, also known as microswimmers, are capable of driving themselves out of equilibrium by taking up energy from their environment and converting it into directed motion. Therefore, understanding their motion can provide insight into out-of-equilibrium phenomena associated both to biological entities such as bacteria and to artificial microswimmers. We have develop several kinds of novel microswimmers and we are employing them to explore new applications in the localization, pick-up and delivery of microscopic cargoes for, e.g., biomedical applications.

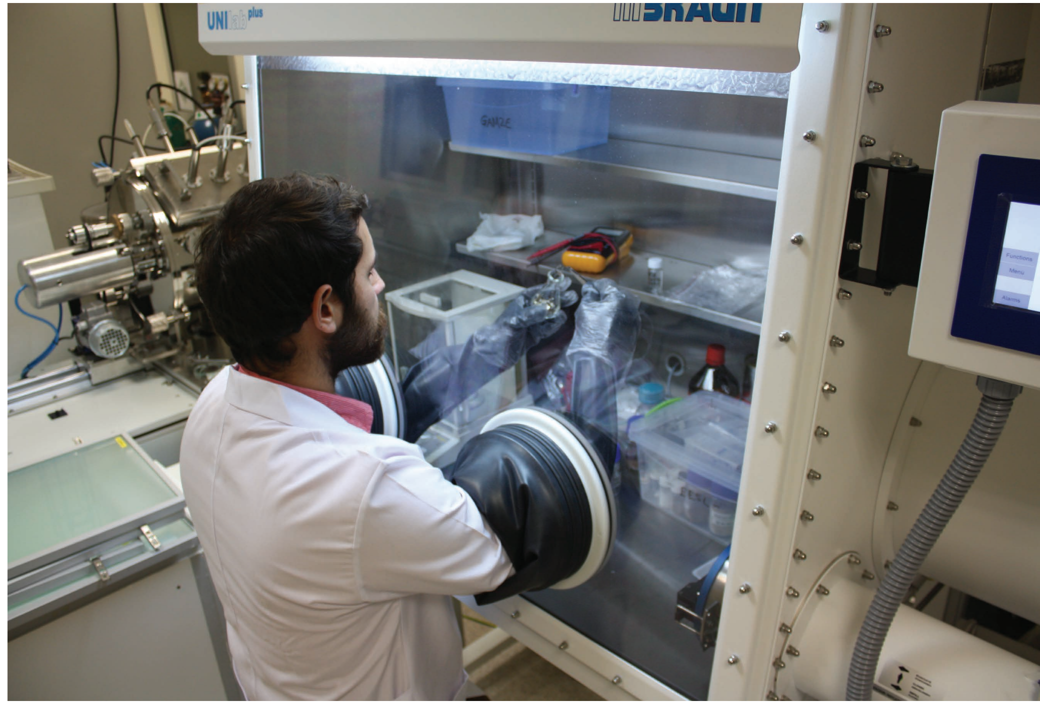


“The intersection of statistical physics, soft matter and optical manipulation creates us opportunities in a variety of applications.”

Dr. Eda Yılmaz

Electrochemical Energy Storage Systems

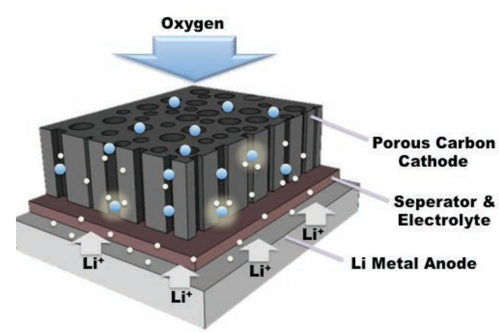
Energy storage has become one of the most challenging issues in recent years. Our research objective is to build "better" batteries, with higher capacity, stability and power density for various applications like portable electronics, electric vehicles and grid energy storage. We employ advanced characterization techniques and nanomaterial based synthesis approaches to develop innovative materials for batteries.



Lithium-Oxygen Battery

Lithium-ion batteries changed our perception of portable electronics when they were made commercially available in the early 90s. With the high power density and stability lithium-ion battery offered, smaller and rechargeable portable electronics were made possible. Nevertheless, the energy needs of emerging technologies are ever increasing, while the lithium-ion batteries can no longer supply the necessary energy densities needed by these new systems. Lithium-oxygen (or lithium-air) battery is a very recent and promising battery technology with 10 times higher energy storage capacity compared to lithium-ion battery. Using lithium-oxygen batteries, portable electronics with much longer usage times and electric vehicles with much extended driving ranges per charge can be achieved.

Lithium-oxygen battery discharges by the reaction of Li^+ ions with O_2 at the cathode ($2\ Li^+ + O_2 + 2e^- \leftarrow\rightarrow Li_2O_{2(s)}$ U_0=2.96 V), and Li_2O_2 is produced. Likewise, Li_2O_2 is decomposed during charging and yield Li^+ and O_2 back, completing the cycle. To accommodate discharge and charge reactions, a conductive porous cathode is used. We aim to enhance the performance of lithium-oxygen battery using nanostructured porous cathodes, tailored for the specific needs of this system. Moreover, developing effective cathode catalysts, protecting lithium anode surface from side reactions by thin film coatings and establishing the electrolyte stability are also included in our research objectives. By a multi-faceted approach to the current challenges of lithium-oxygen batteries, we're working towards to offer a viable solution for the crucial energy storage problem.



"Battery cell test set-up with multichannel potentiostat/galvanostat. In Electrochemical Energy Storage Laboratory, design and synthesis of novel materials for lithium-oxygen and lithium–ion batteries is supported by testing these materials in battery cells."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PUBLICATIONS & ACHIEVEMENTS

PUBLICATIONS

Doldur-Balli, F; Ozel, MN ;Gulsuner, S ;Tekinay, AB ;Ozcelik, T ;Konu, O; Adams, MM. Characterization of a novel zebrafish (Danio rerio) gene, wdr81 associated with cerebellar ataxia, mental retardation and disequilibrium syndrome (CAMRQ), BMC NEUROSCIENCE, 1471-2202, DEC 23, 2015, 16, 96. DOI 10.1186/s12868-015-0229-4

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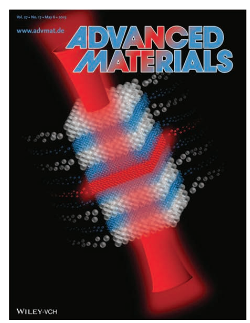
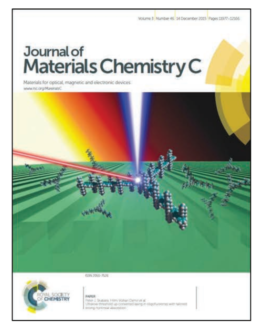
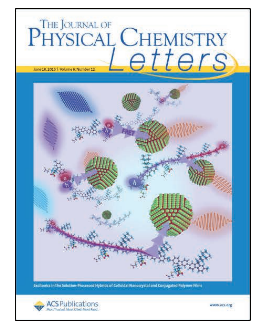
Toren, Pelin; Ozgur, Erol; Bayindir, Mehmet, Real-Time and Selective Detection of Single Nucleotide DNA Mutations Using Surface Engineered Microtoroids. ANALYTICAL CHEMISTRY, NOV 2015, 10920-10926. DOI 10.1021/acs.analchem.5b02664

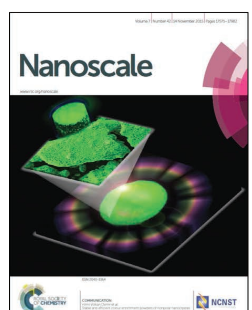
UNAM research groups have pioneered the development of novel methods and techniques, which were published on highly respected, international, refereed journals. In 2015, UNAM reserchers published 126 journal articles.

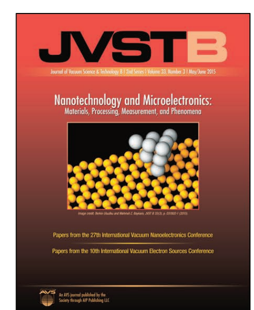
Some of these studies were selected as cover articles which demonstrates the revolutionizing potential of these studies.











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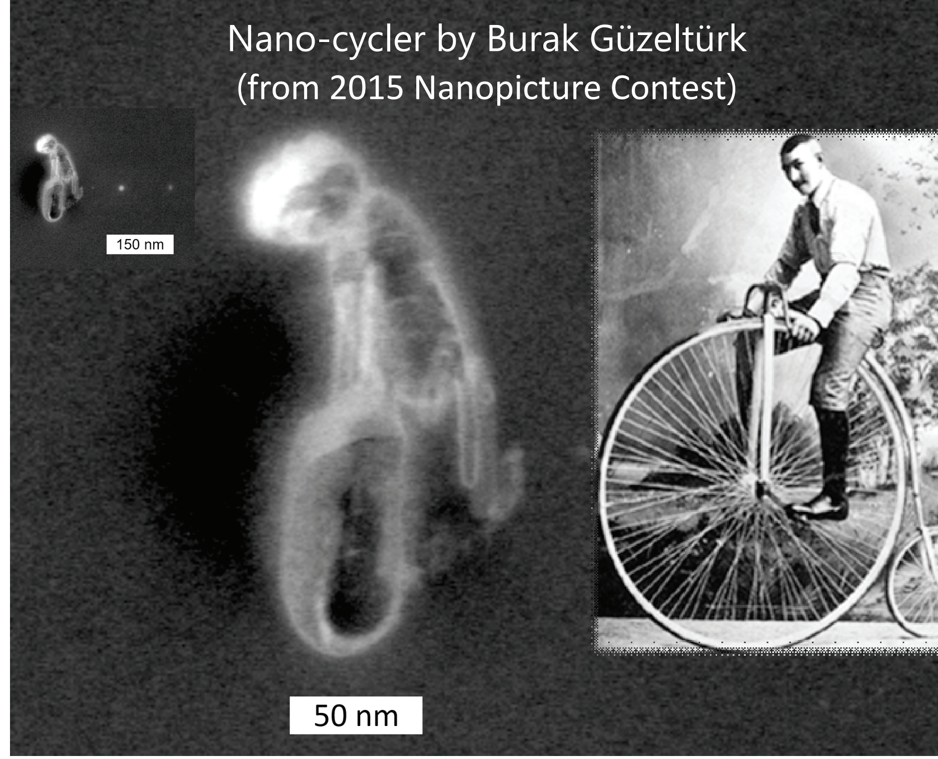

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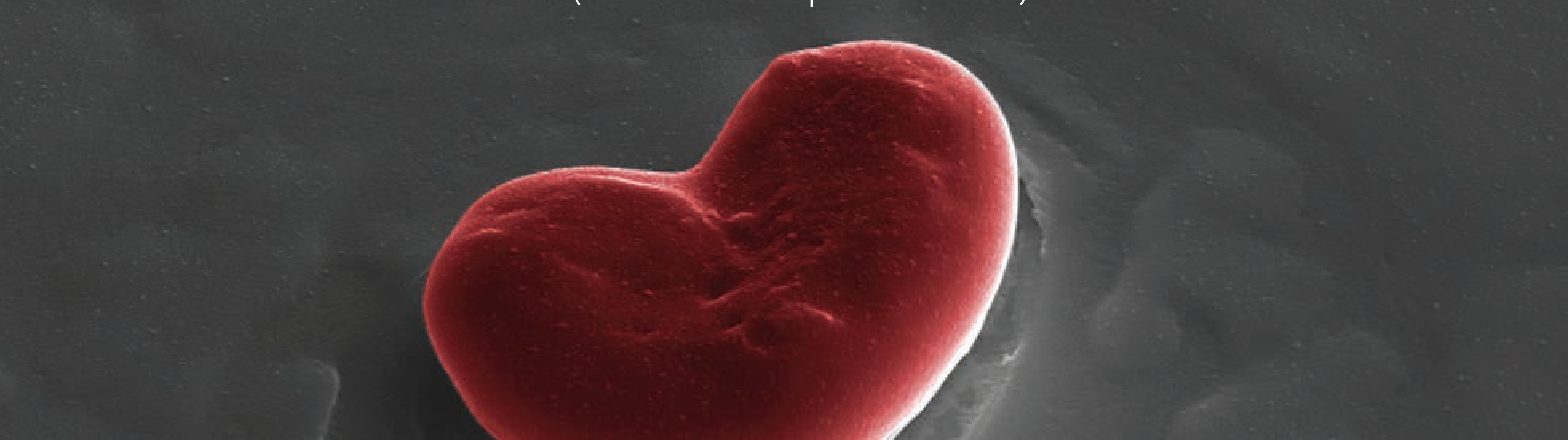

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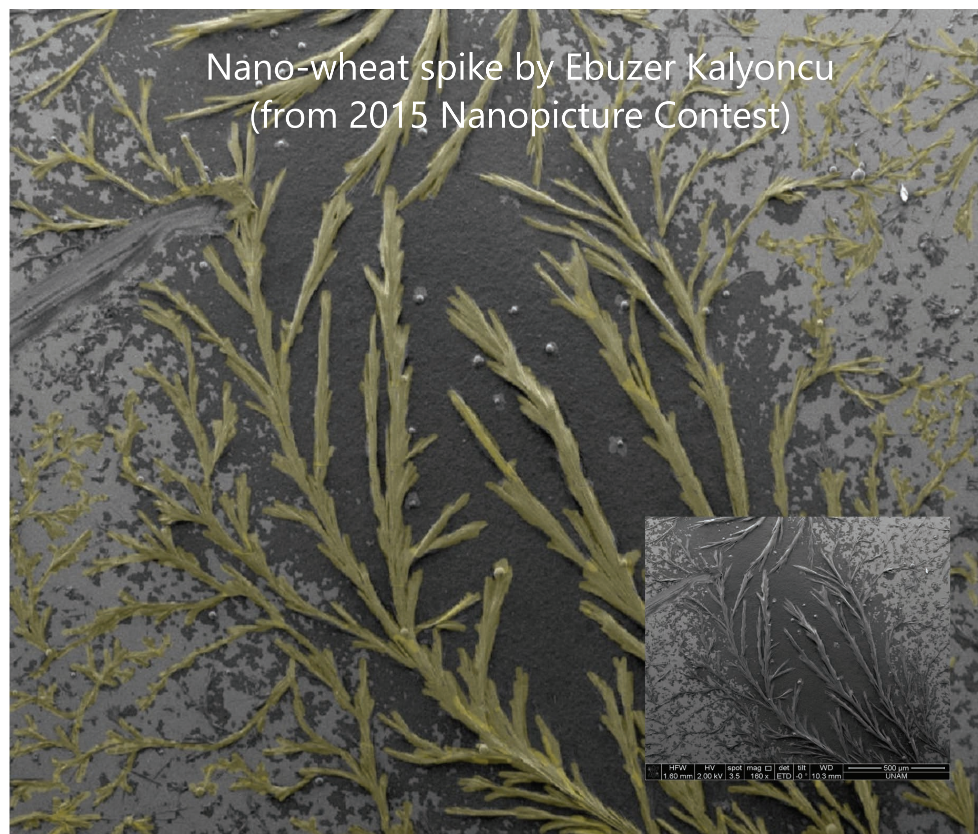

Nano-wheat spike by Ebuzer Kalyoncu
(from 2015 Nanopicture Contest)

Nano-wheat spike by Shahid Ali Leghari
(from 2015 Nanopicture Contest)

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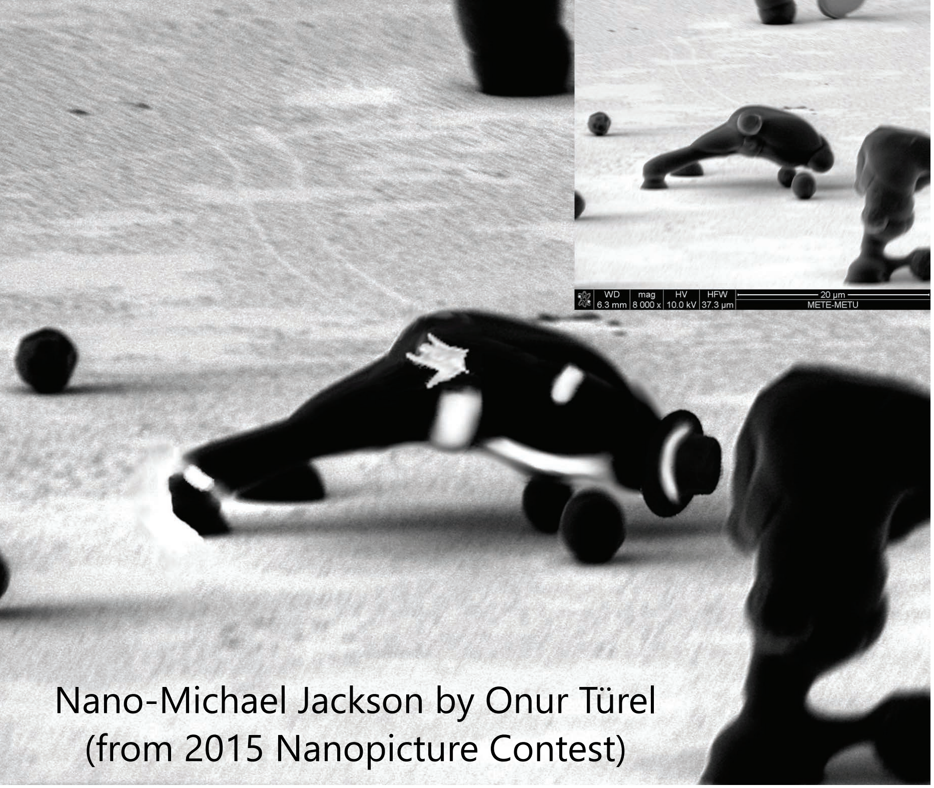

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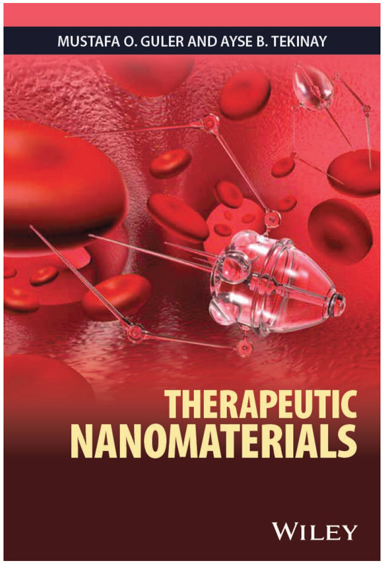
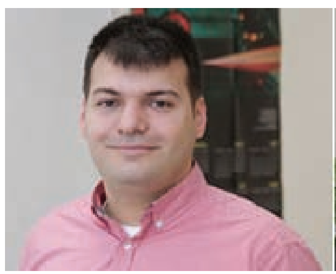
UNAM Faculty to Publish Textbook on Nanotechnology



Drs. Mustafa Özgür Güler and Ayse Begüm Tekinay have recently coauthored a new book entitled Therapeutic Nanomaterials to be published by Wiley. Intended as a general-use textbook for the biomedical applications of nanotechnology, the book covers topics as diverse as implants, biosensors, tissue adhesives, drug delivery vectors and imaging techniques, and discusses their use in relation to the unique properties of specialized tissues such as bone, cartilage and the nervous system. The design, development and in vitro (cell culture-based) and in vivo (animal-based) testing of next-generation nanomaterials is also outlined in the book, with emphasis on the physiological responses associated with wound healing and the modulation of the recovery process through the use of bioactive chemical groups. Recent advances in the design of three-dimensional culture scaffolds and the merits and demerits of natural, synthetic and hybrid materials are among the topics discussed in this context.

PRIZES & AWARDS

UNAM researcher Asst. Prof. Dr. Engin Durgun received TUBA-GEBİP Award of 2015 in the field of Physics. Launched in 2001, TÜBA-GEBIP award programme aims to foster young, outstanding scientists who are at the stage of establishing their own research programmes in Turkey after finishing their post-doctoral research activities. TÜBA supports these scientists for a period of three years and helps them set up their own research groups at a stage when they are in need for incentives. edure among GEBIP candidates has very high standards and GEBIP programme is considered as a source of prospective members to the Academy.
Asst. Prof. Dr. Engin Durgun has recently been announced as a recipient of the 2015 Mustafa Parlar Research Award, granted in recognition of his contributions to the fields of physics and materials science. Honoring the METU scholar Mustafa Parlar, the awards have been distributed yearly since 1981.



Asst. Prof. Ali Kemal Okyay, Engin Durgun and Urartu Özgür Şeker received FABED Distinguished Young Scientist Award

UNAM researchers Asst. Prof. Engin Durgun and Res. Asst. Prof. Urartu Özgür Şafak Şeker are recipients of FABED Eser Tümen Outstanding Young Scientist Awards for 2015 in the fields of physics and biology. Granted each year to researchers under the age of 40 who have chosen to establish their careers in Turkey, the Eser Tümen awards recognize mid-career scientists who have made major contributions to the country's academic prowess.
Dr. Durgun won the award for his research in the area of 2-dimensional materials, cement reactivity and cyclodextrin inclusion complexes, while Dr. Şeker received his award for his contributions to synthetic biology-enabled systems and bionanotechnology.

Asst. Mehmet Z. Baykara received 2015 JCI TOYP Scientific and Technological Development Prize

The Outstanding Young Persons of the World (TOYP) program serves to formally recognize young people who excel in their chosen fields and exemplify the best attributes of the world's young people. The program is sponsored by Junior Chamber International (JCI).

Asst. Prof. Mehmet Baykara and Ali Kemal Okyay Award and Distinguished Young Scientist (BAGEP) Award

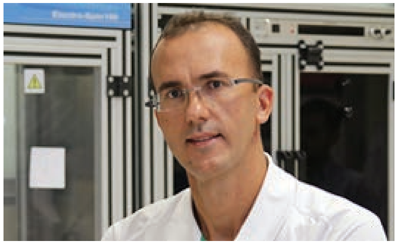
UNAM researchers Asst. Prof. Dr. Ali Kemal Okyay and Asst. Prof. Dr. Mehmet Baykara received 2015 distinguished young scientist (BAGEP) awards. The awards are given by the Science Academy Association (Bilim Akademisi Derneği) which was established in 2011, in order to recognize and support outstanding young scientists working in Turkey.

European Research Council

Bilkent University Department of Physics, UNAM and Neurosciences faculty member, Assistant Prof. Dr. Giovanni Volpe has been awarded a European Research Council's (ERC) Starting Grant. Dr. Volpe will be using the funding provided by the council for 5 years for his research project titled "Biocompatible and Interactive Artificial Micro- and Nanoswimmers and Their Applications".

Dr. Coşkun Kocabaş of the Department of Physics has been awarded a European Research Council (ERC) Consolidator Grant. Dr. Kocabaş will be using the funding provided by the council for five years for his research project, "Graphene-Based Smart Surfaces: From Visible to Microwave."

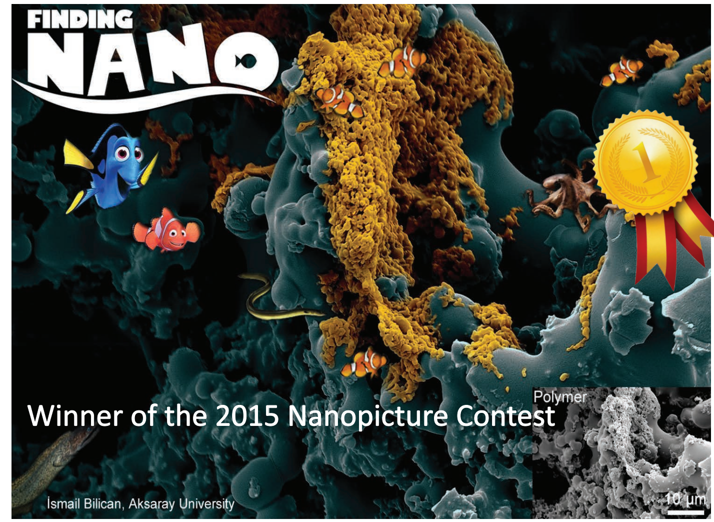
Assoc. Prof. Mustafa Özgür Güler of the Institute of Materials Science and Nanotechnology and UNAM has been selected to serve as an associate editor for the Royal Society of Chemistry's journal, RSC Advances. RSC Advances is an international, peer-reviewed journal covering all of the chemical sciences, including multidisciplinary and emerging areas.



Assoc. Prof. Tamer Uyar is appointed as a Founding Editor of new journal Electrospinning,www.degruyter.com/view/j/esp, launched recently by De Gruyter Open (www.degruyteropen.com). This is the only journal dedicated solely to electrospinning and electrospun materials, which is maintained by the many prominent scholars on its Editorial Team and Editorial Advisory Board. It covers various aspects of electrospinning of micro or nano scale fibers, including electrospinning process and modeling, electrospun materials and characterization as well as their diverse applications.

UNAM NANODAY 2015

UNAM has ogranizde the second Nanoday event on 15 May 2015. UNAM is hosting Nanoday events annually and each year word renowned scientist are invited to this one day event. UNAM's seminar series have closed for the semester with a full-day event, Nanoday '15, featuring a nanopicture contest and poster presentations as well as keynote talks by four world-renowned researchers. Prof. Christoph Gerber (University of Basel), Prof. Dave Blank (University of Twente, MESA+), Prof. Oliver Schmidt (Leibniz Institute for Solid State and Materials Research) and Prof. Matthew Tirrell (University of Chicago) were the speakers for the annual event.

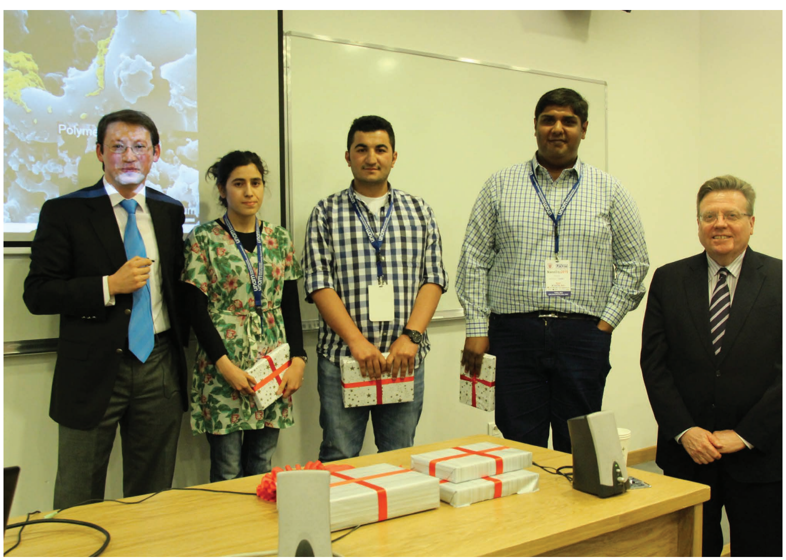


Winner of the 2015 Nanopicture Contest

Dr. Gerber, an eminent scientist noted for his contributions to the invention of scanning tunneling and atomic force microscopies, presented the first talk of the day on the development of cantilever-based nanom echanical detection methods for advanced medical diagnostics.

Dr. Tirrell from the Institute for Molecular Engineering from the Univeristy of Chicago is delivering his talk on the use of peptide nanostructures as bioactive materials for disease diagnostics and treatment.

Dr. Blank, director of the MESA+ Institute for Nanotechnology, who detailed his use of the reflection high-energy electron diffraction (RHEED) technique for the fabrication of thin films of alternating material compositions and precise control over material boundaries



The day's talks were followed by an awards ceremonyfor the winners of the poster andpicture contests. İsmail Bilican, Nuray Gündüz and Talha Masood Khan won the nanopicture contest, while Mehmet Girayhan Say, Burak Güzeltürk and Anitha Senthamizhan received the poster presentation award

OUTREACH

WORKSHOPS

5th International Workshop on Applications of Nanoscience and Technology (IWANN-5) : Design, fabrication and characterization of nanostructures

UNAM has recently hosted the 5th International Workshop on Applications of Nanoscience and Technology (IWANN-5), a two-week workshop and seminar series on the design, fabrication and characterization of nanostructures. Sponsored by the Turkish Ministry of Science, Industry and Technology, Turkish International Cooperation & Coordination Agency (TİKA) and Turkish Ministry of Development, the program was attended by 38 participants from 9 countries.Born out of a joint initiative of UNAM and UNIDO, the first of the IWANN workshops has been held in 2010, and its great success had resulted in the continuation of the event as an annual series. While the previous years focused on application-based topics such as renewable energy, sensor technologies and lab-on-a-chip systems, this year's event concerned the growth and synthesis of nanomaterials – the optimization of which provides the groundwork from which all applications of nanotechnology derive.
he program featured keynote talks by two illustrious researchers, Dr. İlhan Aksay of Princeton University and Dr. Tuomo Suntola of Picosun Oy and Tampere University of Technology, on the design of multi-functional materials and the advanced uses of ALD, a high-precision material deposition technique.

In addition, Bilkent University and UNAM faculty members provided lecture seminars on various aspects of functional nanoscale materials growth and synthesis, covering alternative bottom-up and top-down methods such as self-assembly, chemical/physical vapor deposition, transfer of two-dimensional membrane materials, atomic layer deposition, fiber drawing, electrospinning and laser-assisted nanoparticle synthesis..
This year's workshop covered an impressively large list of equipment, with sessions on ALD-based thin film growth, PVD using E-beam evaporator, graphene membrane transfer, nanofiber synthesis via electrospinning, VO2 nano-beam growth via PVD, Kelvin probe microscopy, fiber drawing, and graphene synthesis via CVD. Participants also had the opportunity to observe and cross-communicate with fellow scientists while they were instructed on the production of functional nano-scale materials and devices in the UNAM cleanroom and specialized labs. In parallel to the hands-on sessions, equipment vendor technology workshop sessions were provided by Thermo Fisher Scientific-Redoks, Malvern & Tescan-Atomika, and Ultratech/CambridgeNanotech.

OpenLab and Crystallographic Training in X-ray Powder Diffraction Workshop

UNAM hosted a Crystallographic Training in X-ray Powder Diffraction Workshop. The workshop was oorganized with UNESCO/International Union of Crystallography initiative in collaboration, PANalytical BV, Atomika Teknik, and UNAM, the National Nanotechnology Research Center at Bilkent University in Ankara and the Turkish Crystallography Association (TCA The focus of the event was to better disseminate the current corpus of knowledge on crystallography, both in theory and in practice. True to this aim, lectures covering a broad range of topics, including x-ray physics, data collection and analytical methods, were presented in the conference, and attendees also had the chance to participate in hands-on training with powder diffraction instruments in UNAM.

Prof. Gilberto Artioli, an eminent researcher who has co-authored the quintessential crystallography textbook, “Fundamentals of Crystallography”, and authored the book “Scientific Methods and Cultural Heritage”, delivered a series of lectures on the theoretical aspects of crystallography, while Marco Sommariva of PANalytical conducted the hands-on training sessions. Sample preparation, instrumental configurations and basic measurements were covered in the training session, and participants also had the opportunity to measure their own samples and consult experienced crystallographers on more specific cases. The participants conveyed their gratitude and satisfaction with the event, remarking that such events must be organized more often due to their exceptional contributions to their research and knowledge.

UNAM hosted the 2nd International Training School on Electrospinning of Nanofibers

Between 10-12 June 2015, Dr. Tamer Uyar and his research group organized the 2nd International Training School which was financially supported by COST Action MP1206-”Electrospun nano-fibres for bio inspired composite materials and innovative industrial applications” and UNAM, Bilkent University. Upon the great success of the first organization in 2014 (June 11-13) with the attandence of nearly 50 participants from 18 different countries, Uyar Research Group continued this training school series this year as well.

This year, nearly 75 participants from 17 countries consists of experts, postdoctoral fellows and PhD students were participated. In this training school, the focus was on Advanced Characterization Techniques for Electrospun Nanofibers: Hands-on Experience. Besides classroom lectures and seminar talks, hands on experience on electrospinning unit for the production of nanofibers and the detailed advanced characterization of nanofibers by Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM), Confocal Raman Microscope and X-ray Photoelectron Spectroscopy (XPS) was provided at UNAM, Bilkent University.

UNAM Ph.D. candidate awarded SPIE Optics and Photonics Education Scholarship

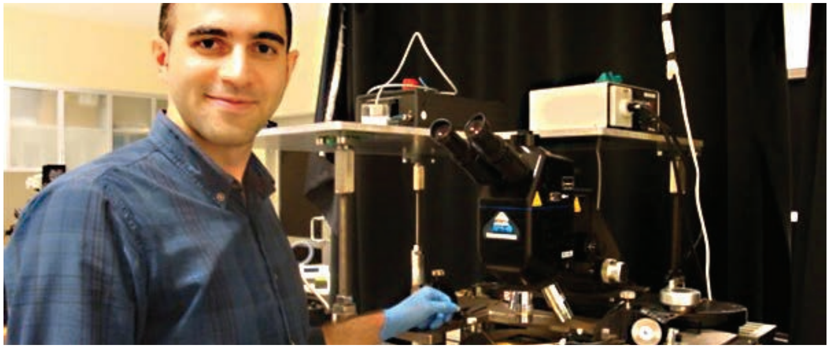
Yusuf Kelestemur has been awarded a 2015 Optics and Photonics Education Scholarship by SPIE, the international society for optics and photonics for his potential contributions to the field of optics, photonics or related field.

Kelestemur is pursuing his PhD degree under the supervision of Professor Hilmi Volkan Demir in the Department of Material Science and Nanotechnology at the Bilkent University (Turkey). He is working on the colloidal synthesis of semiconductor nanocrystals having different dimensionalities and architectures for next-generation colloidal optoelectronic device applications including highperformance nanocrystal-based light-emitting diodes and lasers. Kelestemur has coauthored numerous conference papers and 15 scientific journals including Advanced Materials, ACS Nano, Small and Nanoscale.

UNAM Ph.D. candidate won Photonics21 Student Innovation Award

Burak Guzeltruk from the Bilkent University in Turkey was awarded for his outstanding photonics research work on all colloidal lasers of solution-processed semiconductor quantum dots and quantum wells. In his PhD work, all-solution-processed lasers of colloidal semiconductor nanocrystals are developed offering single-material, full-color and highly-efficient laser technology promising for a broad range of applications including displays, spectroscopy and biomedicine. In his work, ultra-low optical gain thresholds and record-high optical gain coefficients are demonstrated in the colloidal nanocrystals through tailoring of the architecture and dimensionality in these materials. His achievements highlight that the colloidal semiconductor nanocrystals are bright materials as next-generation optical gain media.

UNAM Ph.D. candidate awarded IEEE Student Fellowship



Shahab Akhavan, a PhD student in the Institute of Materials Science and Nanotechnology, has received an IEEE Electron Devices Society PhD Student Fellowship.

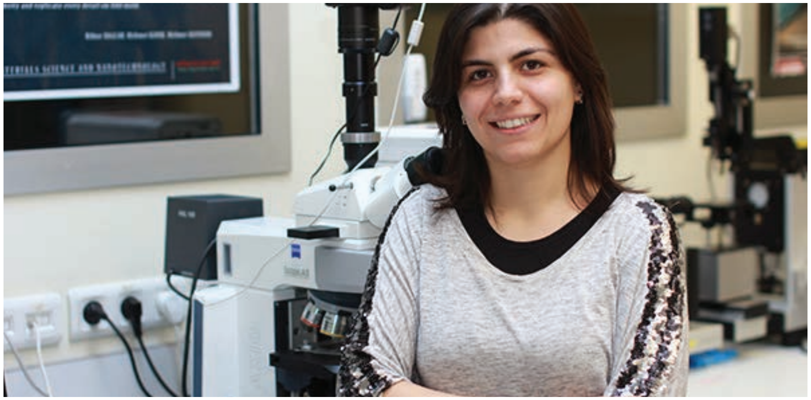
Every year, the IEEE Electron Devices Society awards these fellowships to three outstanding candidates chosen from around the world on the basis of their demonstration of marked ability to conduct high-quality scientific research work and a proven record of academic excellence.

UNAM Ph.D. candidate won Photonics 2015 Best Poster Award

Graduate Student Abubakar Adamu, a researcher from National Nanotechnology Research Center (UNAM) won the 1st position in the 17th annual Photonics conference, held in Ankara University, Turkey. The workshop, which is one of its kind in Turkey, aimed at advancing technologies in Optics, Electro-Optics and Photonics in the country. This year's event featured over 400 guests from all across the country.

The award winning poster titled "Binary coded identification of industrial chemical vapors with an optofluidic nose" was authored by Abubakar Isa Adamu, Fahri Emre Ozturk and Mehmet Bayindir. They developed an artificial nose system that detects industrial toxic gases with potential applications in ozone monitoring, disease diagnosis and other medical applications.

UNAM Ph.D. candidate Awarded in the 2015 IEEE Photonics Conference



Zeliha Soran Erdem, PhD candidate in the UNAM-Institute of Materials Science and Nanotechnology, is the recipient of the Best Student Paper Award in the 2015 IEEE Photonics Conference (IPC). This award is given annually by the Society, the awards are open to students from universities whose papers have been accepted for presentation at the IEEE Photonics Conference. The top five finalists receive certificates of recognition and monetary awards ranging from $250 up to $1000 for first place.

PATENTS

Patent Number	Author(s)	Title	Place	Date	Status
TR 2015/04...	M. Bayindir, M. Kanık	Spontaneous High Piezoelectricity in Poly(vinylidene fluoride) Nanowires Produced by Iterative Thermal Size Reduction Technique	Republic of Turkey Patent Institute	2015	patent pending
TR 2015/04...	M. Bayindir, M. Kanık	Motion- and Sound-Activated, 3D-Printed, Chalcogenide-Based Triboelectric Nanogenerator	Republic of Turkey Patent Institute	2015	patent pending
TR 2015/04051	M. Bayindir, G. B. Demirel, B. Daglar	Cellulose Based Sensor for Detection of Nitroaromatic Explosives	Republic of Turkey Patent Institute	2015	patent pending
TR 2014/0412	M. O. Guler, A. B. Tekinay, R/ Mammadov	Peptide Nanostructures for Oligonucleotide Delivery	Republic of Turkey Patent Institute	2014	patent pending
TR 2014/0413	M. O. Guler, A. B. Tekinay, M. Sardan, S. Ustun	Glycopeptide Nanostructures for Cartilage Regeneration	Republic of Turkey Patent Institute	2014	patent pending
TR 2013/01349	H. V. Demir et. al.	Enhancement of Magnetic Resonance Image Resolution by Using Bio-compatible, Passive Resonator Hardware	Republic of Turkey Patent Institute	2013	patent pending
TR 2012/02559	H. V. Demir et. al.	Large and Photosensitive Nanocrystal Skin and Manufacturing Method	Republic of Turkey Patent Institute	2012	patent pending
G-104575	M. O. Guler, A. B.Tekinay	Dopa Conjugated Peptide Nanofibers for Bioactivation of Metal Implant Surfaces	Republic of Turkey Patent Institute	2011	issued
G-16885	M. O. Guler, A. B. Tekinay, R. Mammadov, B. Mammadov	Heparin Mimetic Peptide Nanofibers for Growth Factor Binding	Republic of Turkey Patent Institute	2011	issued
G-149978	A. Dana	Plasmon Integrated Sensing Mechanism	Republic of Turkey Patent Institute	2011	issued & commercialized
US 2012122668 EP 2294014 JP 2011519720 CN 102164860	H. V. Demir et. al.	A photocatalytic nanocomposite material	USA, EU, Japan, China	2011, 2012	issued
US2011152725 (A1) KR20110044758 (A) JP2012501237 (A)	H. V. Demir et al.	Biomems Sensor and Apparatuses and Methods Thereof	US; Korea, Japan	2009	issued

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