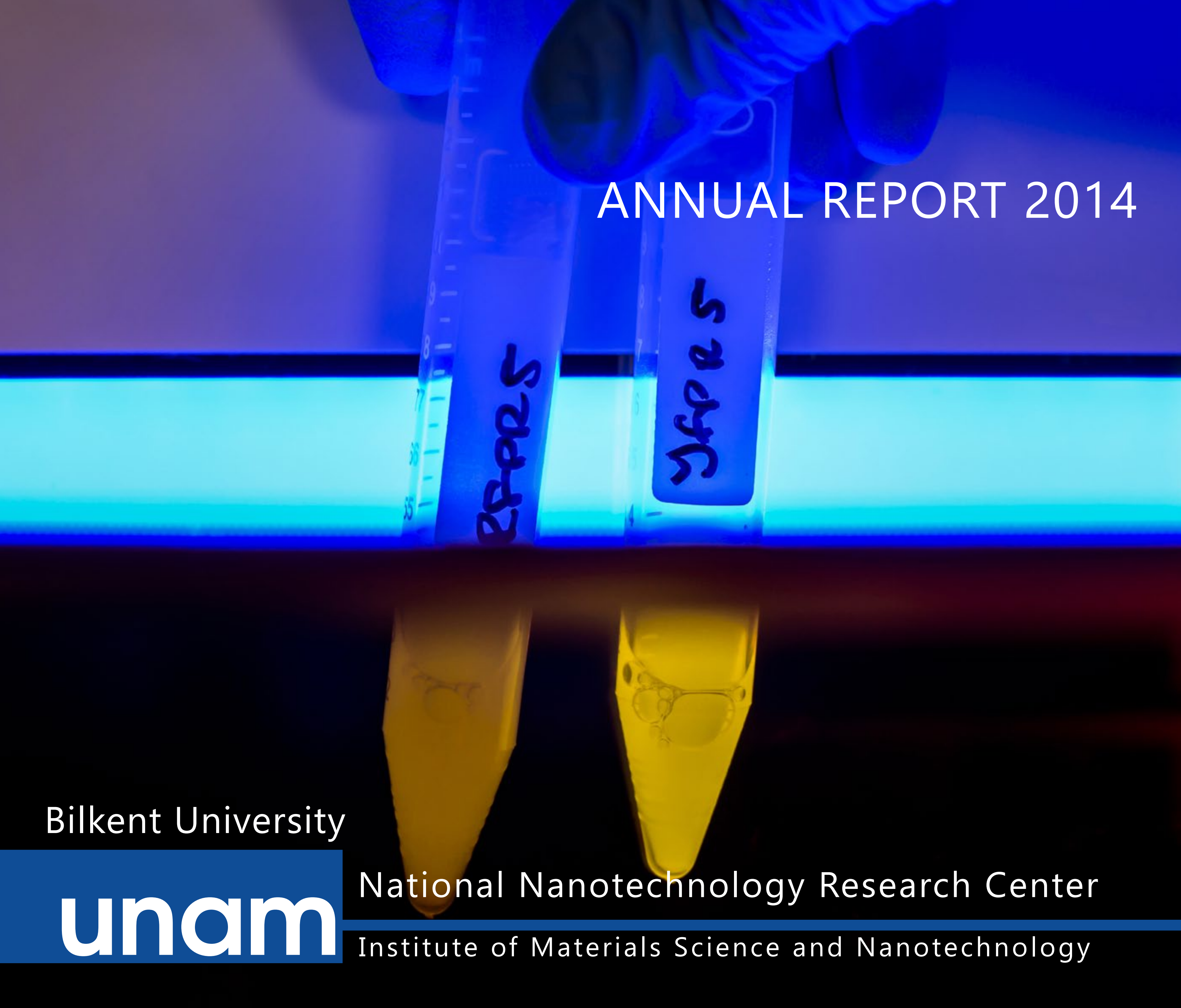


ANNUAL REPORT 2014

Bilkent University

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's Vision and Mission

National laboratories play a critical role in the development of value-added technologies based on advanced scientific research. The centralization of state-of-the-art equipment not only lowers cost in their investment and maintenance, but also ensures the sustainability of their service and availability. In addition to academic researchers, national laboratories also serve the R&D staff in the industry, which minimizes R&D expenditures and expedites the research period for companies by providing access to specialized research facilities. National laboratories also serve as a central hub for know-how exchange by hosting researchers from a variety of disciplines and fosters cooperative efforts between academic and industrial researchers.

Products based on advanced technologies require continuous R&D support in order to succeed in the international market. The competition in developing tomorrow's technologies is fierce and it requires very deep know-how, well-trained personnel and advanced R&D infrastructure. For this reason, developed countries invest heavily on national laboratories.

The establishment of UNAM in 2005 is based on this vision. The initial phase of the UNAM project was completed in 2007 with the investment of Bilkent University and Ministry of Development of Turkey, and the facility soon opened its doors to researchers all across Turkey. In addition, UNAM started offering the Materials Science and Nanotechnology graduate program in 2008. More than 100 graduate students are currently enrolled in this program, and continue their studies under the guidance of UNAM's expert faculty members. UNAM researchers conduct cutting-edge research projects and publish their findings at respected international journals. Researchers also transfer their patented technologies to the industry either through licensing or their own spin-off companies.

UNAM provides complete access to interested companies and researchers from all universities. This provides a significant opportunity to all of the researchers across the country to advance their studies. The effectiveness of UNAM's organizational structure is reflected in the scientific and technological output of researchers utilizing the facility. After its establishment, UNAM has successfully completed a second phase project in 2013 and established a reputation for academic excellence despite its young age. UNAM aims to grow further while performing its mission to excel as a research center, conducting advanced research, generating revenue while producing the necessary know-how to shape the technological development of Turkey and being a role model for other national research centers.

Nowadays, while developing countries seek to avoid the middle-income trap, UNAM's vision outlined a decade ago aims to develop innovative technologies that will lead to value-added, competitive products. UNAM, a young and dynamic institute, has recently completed its establishment and looks forward to a healthy level of growth in the upcoming years, further substantiating its reputation as an institute renowned worldwide for its accomplishments.

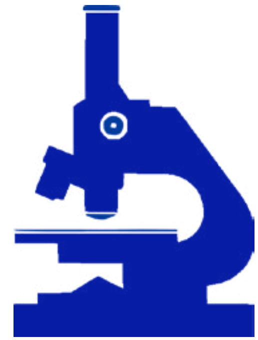
Salim Çıracı
Founding Director


unam

UNAM WITH NUMBERS

9200 m^2 total laboratory space

$35 million investment

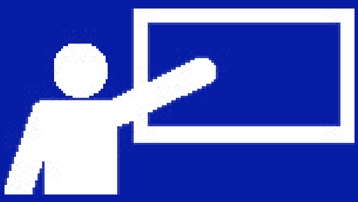


65
laboratories

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 approaching to 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 $25 million
running research budget

71
active projects



18
workshops organized and hosted

376 researchers

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

800 users

- 550 from academia
- 250 from industry

over 700

high impact journal articles in the last 5 years

14
spin-off companies

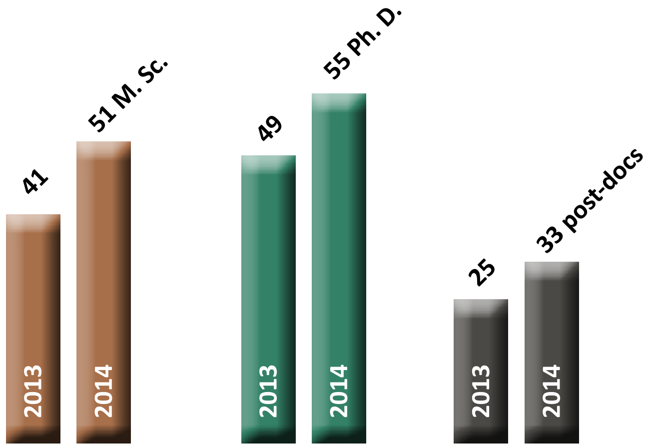
30
patents

61
awards

96
alumni

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	Biyonesil	Co-founder
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
Mecit Yaman	University of the Turkish Aerospace Association	Associate Professor
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
Handan Acar	University of Chicago	Post-doctoral Researcher

Aslı Çelebioğlu	Bilkent University	Post-doctoral Associate
Deniz Kocaay	IMEC-Inter University Microelectronics Centre	Ph.D. Student
İnci Dönmez	METU-MEMS	Researcher
Mehmet Alican Noyan	ICFO-The Institute of Photonic Sciences	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	Yılmaz Kimya A.Ş	Scientist
Fatma Kayacı	TÜBİTAK-SAGE	Specialist
Adem Yıldırım	University of Colorado	Post-doctoral Researcher
Ruslan Garifullin	Bilkent University	Post-doctoral Researcher
Seydi Yavaş	FibLas Fiber Lazer	Engineer

A WORD FROM THE ALUMNI

I am one of the second generation PhD graduates of UNAM. After completing my PhD in February 2014, I worked at UNAM as a postdoctoral research associate until December 2014. Since the day it was established, UNAM meets the demands of researchers from academia and industry with its 7/24 accessible infrastructure. Having the opportunity to work and gain hands-on experience at UNAM cleanroom facility (UCF) and characterization laboratories – all of which equipped with a wide variety of state-of-the-art equipment – improved my knowledge and skills. I also admire the interaction and collaboration of different research groups, which not only extends the knowledge and vision of students but also paves the way for high quality research. I believe UNAM's world-class interdisciplinary research environment will be a role model for Turkey's future leading research institutions.

Dr. Çağla Özgit-Akgün

I have received my master and doctoral degrees from UNAM between 2007 and 2014. In the course of this time, I have had the chance of working on different research subjects with several researchers from wide range of disciplines. I think this interdisciplinary research environment of UNAM is an indispensable opportunity for the researchers. In addition, the widespread resources of UNAM help to improve the quality of the ongoing research in UNAM and as well as in other Institutes those benefits from these resources. I would like to thank to everyone who contributed the establishment of UNAM and all the friends and colleagues.

Dr. Adem Yıldırım

Certainly, UNAM years were transformative experience for me. Part of it was related with chemistry and materials science perspective on biological problems I believe I gained in those years. My focus was mainly peptide-based nanofiber materials and I had great chance to study chemical and other material properties behind beautiful and promising biological phenotypes. As a biologist, I feel I understood the very basic concepts of biology in UNAM. There was no possibility of these could happen without the communication I had with the bright and philosophical minds, who were gathered in UNAM, and their hospitality. Thank you!

Dr. Rashad Mammadov

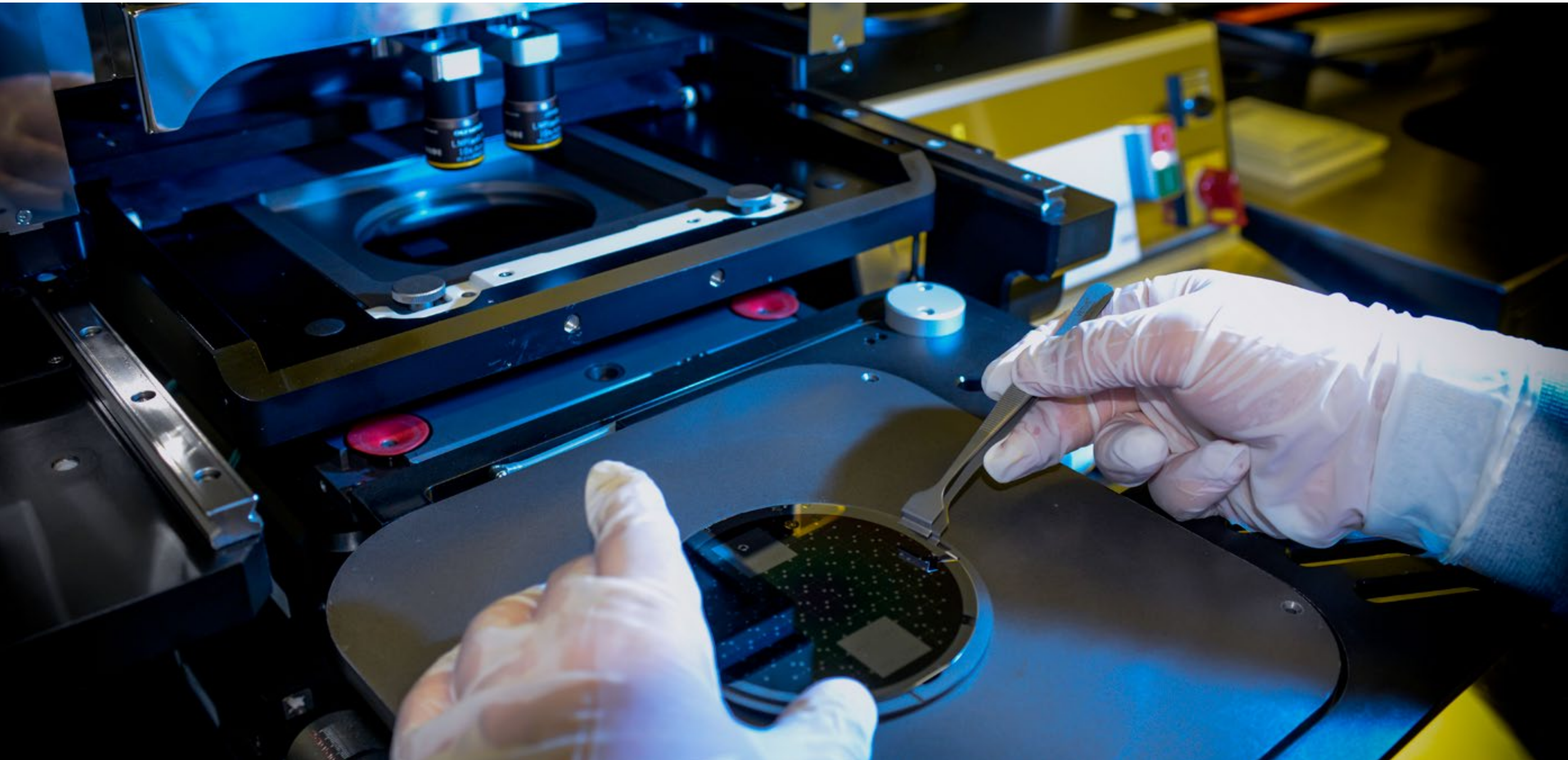
UNAM has successfully established a tradition of innovative and interdisciplinary research, which inspired me greatly during my PhD studies. Collaboration with researchers from diverse expertise helped me pursue interesting questions where no one has ever considered before. We greatly benefited from this productive research environment, which resulted in publications in highly respected top journals. In that sense, UNAM is truly a center of excellence for frontier materials and nanotechnology research in Turkey and Europe.

Dr. Hakan Ceylan

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

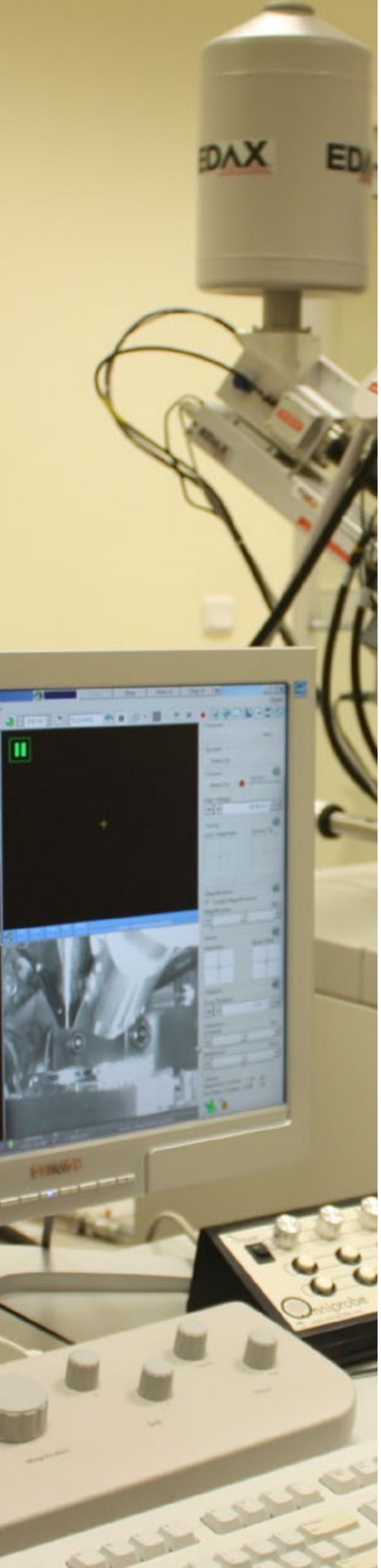
- Atomic Force Microscope (AFM, PSIA)
- Atomic Force Microscope (AFM, Asylum)
- Confocal Microscope
- Dual Beam
- E-Beam Lithography (E-BEAM)
- Environmental Scanning Electron Microscope (ESEM)
- Fluorescent and DIC Equipped Upright Microscope
- Fluorescent and DIC Equipped Inverted Microscope
- Material 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


DWL 66FS
HEIDELBERG
INSTRUMENTS

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
Beren Ecza Deposu
Betopan
Biyotez Makine
Boylam Yazılım
Cyberpark
Deltamed Hacettepe
Dizayn Grup
Drogsan Eczacılık
Dyo Boya
E-A Teknoloji
Eczacıbaşı
Embil İlaç
Eti Maden
Gata
Genamer Ar-Ge
Hemosoft
İksa Ltd.
Kordsa
Man
Meteksan
Mikron Makine
Mono Kristal Arge
Maden Tetkik Arama
Nanodev
Norm Tıbbi Ürünler
Nurol Teknoloji
Paşabahçe
Plant Tıbbi Ürünler
PMS Medikal
Roketsan
Sanko Metal
Sanko Tekstik
Silyon Ltd.
So Soğutma
Şişecam
Tai - Tusaş
Tübitak Uzay
Vamet Medikal
Virosens Medikal

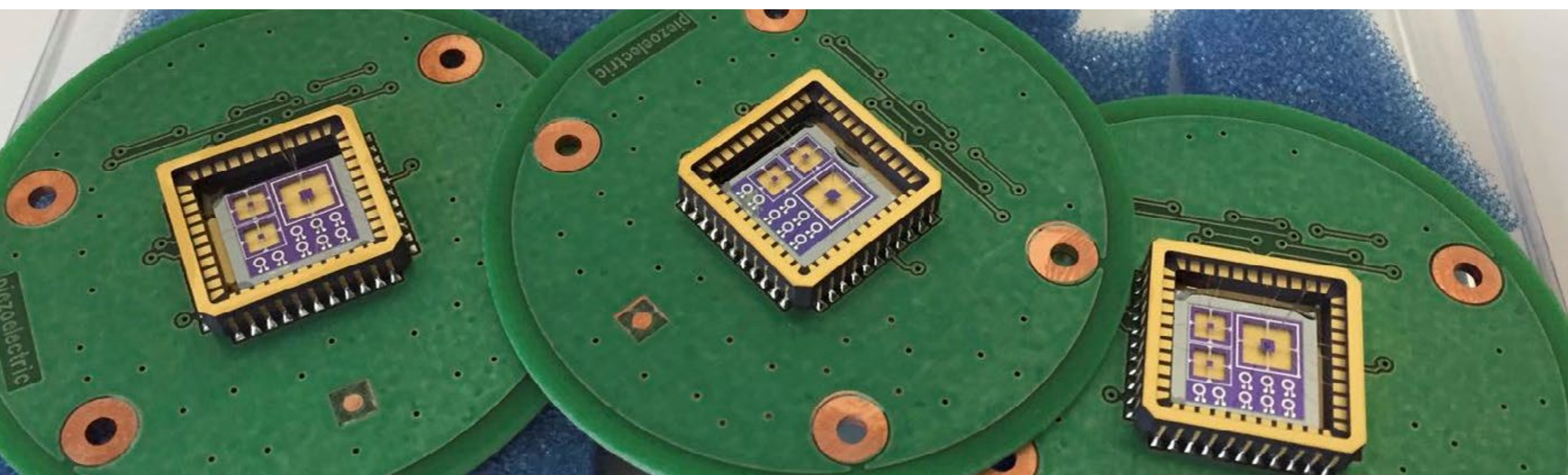
UNAM SPIN-OFFs

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.

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

Yeni Bilge Nanoteknoloji

Yeni Bilge Nanoteknoloji is a nanotechnology R&D company specialized in Atomic Layer Deposition (ALD) systems. It was founded in 2013 with funding from The Scientific and Technological Research Council of Turkey (TÜBİTAK). In 2014, it has successfully completed its first R&D project and built Turkey's first Atomic Layer Deposition (ALD) system. Over the last decade, ALD has found extensive use in nanotechnology industry and research, and has gathered world-wide attention from universities and research institutions. The applications of atomic layer deposited films have already started to find their place in modern CMOS technology, DRAM capacitors and solar cells. We bring this technology within reach by providing customized ALD systems and high quality ALD services to our customers. In addition to ALD technology, our expertise covers a wide span of thin film deposition and characterization techniques and their applications.



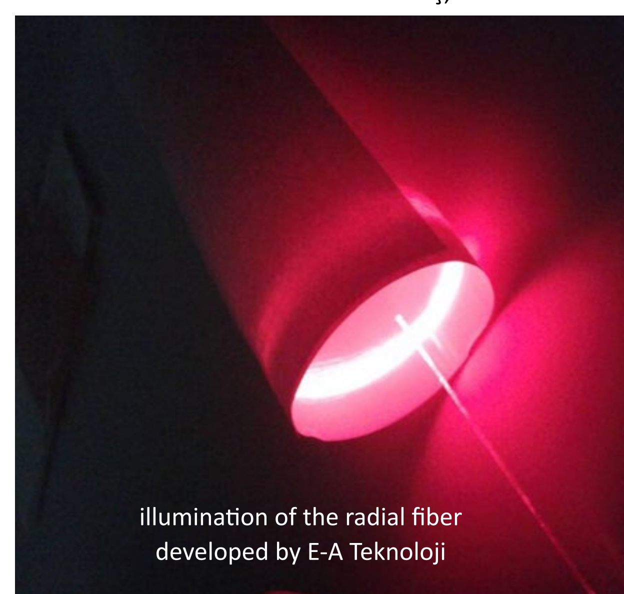
Nanodev Scientific

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

I have had the opportunity to use UNAM laboratories twice. I have performed rheometry in your chemical analysis laboratory during these sessions. Thanks to a reliable appointment system and the attention and skilled contributions of your staff, my time in UNAM has been highly productive. I certainly intend to make use of your laboratories in the future, and express my sincerest gratitude and thanks for providing the opportunity to do so.

Asst. Prof. Dr. Cengiz Uzun
Hacettepe University
Faculty of Science, Department of Chemistry

i5 Doğa Information and Communication Services has been using UNAM facilities for 1.5 years for the development of key technologies in the production of reconfigurable antennae designs. We are greatly pleased with the contribution of UNAM's infrastructure and personnel to our novel value-added, high-export potential RF material and component fabrication projects, and would very much like to continue and develop our collaboration on a long-term basis.

Selçuk Benter
General Manager
i5 Doğa Information and Communication Services
www.i5-comm.com

We have used your facility's EVG620, DWL-66 and Tecnai G2 F30 devices in our clean room, photolithography and transmission electron microscopy (TEM) studies. Your professional conduct and assistance during these measurements, including in sample preparation and device calibration, have allowed us to perform our research rapidly and successfully. It is vital for our work to know that we can use the equipment under your purview with confidence. We express our gratitude for your help and support and wish you success in your operations.

Asst. Prof. Dr. Harun Kaya
İnönü University, Malatya

The cooperation between ATEL Technology and Defence and UNAM has been on-going since 2010. We value very much the efforts of UNAM researchers in following the tight timelines and the project budgets we operate with as well as their particular attention to confidentiality. The partnership of ATEL and UNAM is steadily growing as both parties increase their capabilities. We firmly believe that the contribution of UNAM to the technological development activities all across our country will keep growing.

Haluk Hıdıroğlu, CEO
ATEL Teknoloji ve Savunma Sanayi A.Ş.

www.a-tel.com.tr

I and my research group have been extensively using the rheometer and LC-MS equipment in UNAM during the past two years. We have encountered no major problems with the use of these devices in this time period. We were especially helped with the helpfulness and technical expertise of Zeynep Erdoğan, the technician responsible for these equipment. The usage fees of the devices are also quite reasonable. The most crucial advantage of UNAM is the fact that we can personally perform our measurements, under supervision. This is a great practice and the main reason that we prefer the equipment in UNAM to these in METU's Central Laboratory. Mrs. Erdoğan is again of great assistance for this purpose and provides a thorough instruction on device use, so that users can perform their own measurements after training.

I would like to remark that, generally speaking, I am very satisfied with the usage of UNAM's equipment.

Asst. Prof. Dr. Salih Özçubukçu
Middle East Technical University
Department of Chemistry

ODTÜ

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

Sabancı Üniversitesi

I am a doctoral student in the Micro and Nanotechnology graduate program of TOBB University of Economics and Technology. Our university's Energy Research Laboratory performs research regarding the production of thin films through various methods and the fabrication of devices using these thin films. We extensively use methods such as transmission electron microscopy, atomic force microscopy, X-ray photoelectron spectroscopy, X-ray diffraction spectroscopy and UV-VIS-NIR spectrophotometry for the structural and optical analysis of the thin films we produce. I thank the technical assistance provided for these services that we have purchased at UNAM, and wish you success in your endeavors.

Erkan Aydın
TOBB University of Economics and Technology

TOBB
EKONOMİ VE TEKNOLOJİ
ÜNİVERSİTESİ

Bilkent University's National Nanotechnology Research Center (UNAM) is an institution that we collaborate in our studies. The production of some antennae and microwave structures for the Communication Systems Group's Gamalink project in particular has been performed at UNAM. In addition, UNAM researchers also collaborate with us through scientific counseling. During the course of these studies and counseling efforts, we have observed that the infrastructure of UNAM is capable of performing a wide range of material characterization techniques. We are open to further collaboration, in terms of both equipment infrastructure and trained personnel and scientific experience, with the intent of better consolidating our link with UNAM.

Dr. Lokman Kuzu
Institute Director
TÜBİTAK Space Technologies Research Institute

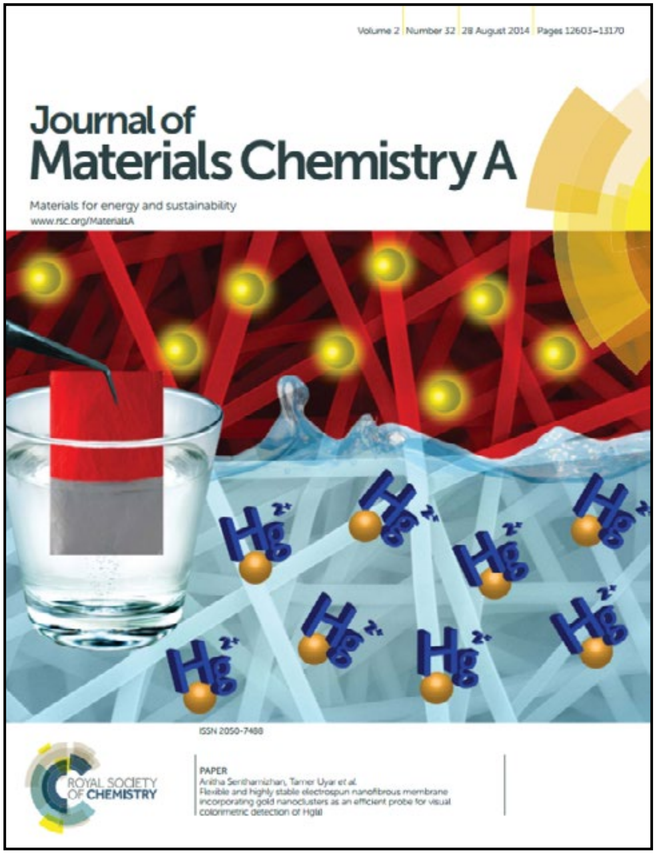
RESEARCH HIGHLIGHTS

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.

In addition to journal publications, some of UNAM's findings were recorded as international and national patent applications. The number of UNAM-based patents and the high-level publication track record of UNAM demonstrate its potential to be a primary hub for original contributions in the field of nanotechnology.

As of February 2014, there are 71 active projects running at UNAM with a total budget of around $25 million. Through these projects, UNAM has established a world-class infrastructure and trained over 450 highly qualified experts. Also, establishing an online reservation system, UNAM-IS (information system), the facility was made available 24/7 to external users.

Visual colorimetric detection of Hg(II) in water



Water pollution caused by heavy metal ions pose a serious threat to mankind and have been a topic of concern for decades. Most importantly, mercury stands out as a prime example of a heavy metal causing damage to the nervous system even when present in parts per million (ppm) concentration. The United States Environmental Protection Agency (US EPA) has set national regulations for the maximum contaminant level of mercury in drinking water to be 2 ppb. Till date various techniques have been developed for the detection of mercury levels using ICP-MS, electrochemical sensors, colorimetric detection and etc. Amongst all these techniques, colorimetric assay of Hg^{2+} has gained a lot of attention among scientists owing to its convenience, facile monitoring, and no requirement of sophisticated instruments.

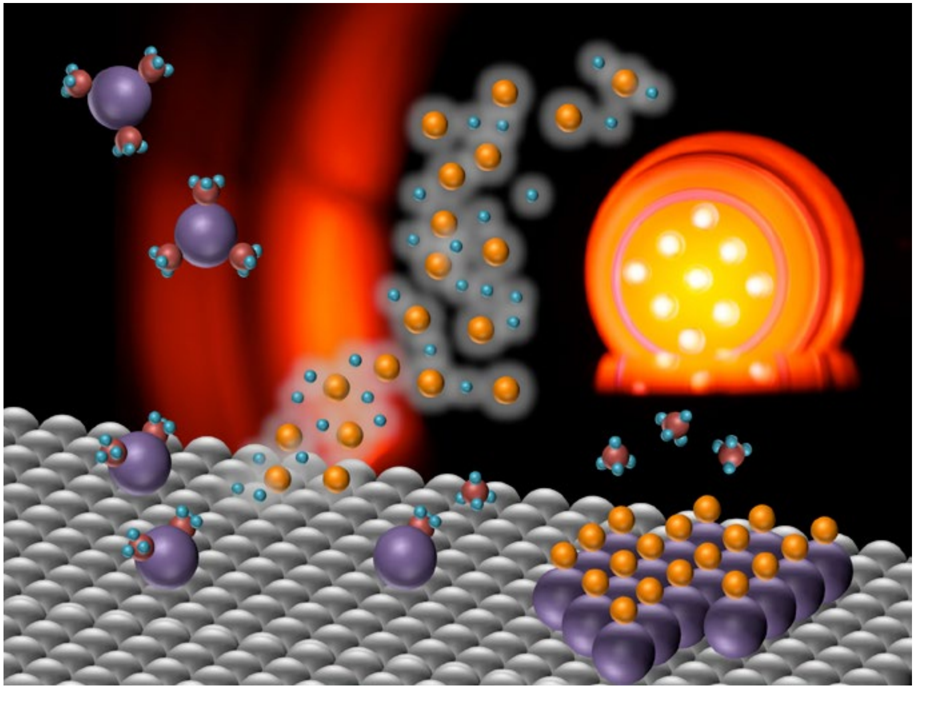
Dr Anitha Senthamizhan and Dr Asli Celebioglu are demonstrated trouble-free "naked eye" colorimetric sensing of Hg^{2+} in water under the supervision of Assoc. Prof Tamer Uyar. They have produced efficient fluorescent fibrous mat by combining the advantages of electrospun nanofibers (cost-effective, relatively easy to handle and have accurate reproducibility) and gold nanoclusters. In addition, in this study several issues have been systematically studied and addressed regarding aggregation, fluorescence quenching, and stability over time and temperature. The water-insoluble fluorescent fibrous membrane has been successfully tailored by cross-linking with glutaraldehyde vapor. Further, they have considered efficient contact mode approach for the visual fluorescent response to Hg^{2+}, and the observed change of color indicates the utility of the composite nanofibers for onsite detection of Hg^{2+} with a detection limit of 1 ppb. Most importantly, the membrane shows selective response towards Hg^{2+} over common toxic metal interferences (Pb^{2+}, Mn^{2+}, Cu^{2+}, Ni^{2+}, Zn^{2+} and Cd^{2+}) in water. The resultant membrane exhibits very useful features of high stability, sensitivity and selectivity have emphasized the utility of the sensor, indicating its practical applications in the environmental monitoring of toxic mercury. The complete study has been published as an Inside Front Cover in J. Mater. Chem. A, 2014, 2, 12717-12723. (DOI: 10.1039/C4TA02295E)

Playing it cool: Low-temperature nitride thin films synthesized at UNAM

While the end product may be shiny and sleek, the making of modern electronics is a messy business: the interiors of micro and nano-fabricated devices are often no different than a blacksmith's forge. This is hardly a problem when working with metals and silicon, but finickier materials melt and deform under such abuse, preventing their use in the design of many devices – and it is precisely these materials that show the greatest promise in bendable electronics, high-efficiency solar cells and many other next-generation technologies.

The fabrication of gallium nitride, a strong contender for silicon's throne as the prime material in electronics, has long been plagued by an incompability with fast-melting plastics and polymers – but two research groups at UNAM may now have found a way to save these materials from the inferno of a latter-day forge, bringing the growth temperatures from typical some thousand degrees to just below 200 °C. Borne out of a collaboration between the teams of Asst. Prof. Ali Kemal Okyay and Asst. Prof. Necmi Bıyıklı, the new method is centered on atomic layer deposition, a low-temperature cyclic film growth technique that employs sequential exposures of different species of gaseous precursor molecules to grow alternating layers of metal oxide thin films. With its layer-by-layer growth mechanism, ALD provides a powerful alternative method for dense and low-defect films (which is critical for high-performance electronic components) and offers exceptional control over thin film thickness as well as ultimate degree of coating conformality.

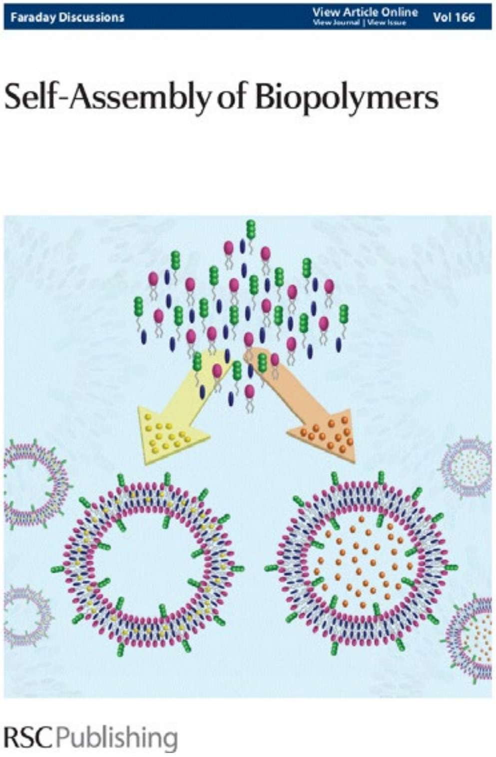
More importantly, they used a specific plasma source (hollow cathode) in their plasma-assisted ALD system, which not only led to low-oxygen content crystalline films, but allowed the growth reaction to proceed at lower temperatures as well – just add the right precursors (the team used trimethylgallium and a nitrogen-hydrogen mixture for their GaN films), turn on the system, wait as it cycles through the layers and get your thin film without toasting your previously deposited polymers. This type of low-temperature technique is particularly effective for connecting individual circuit elements in a mostly-finished electronic device – the so-called back-end-of-line processes as well as flexible electronics. Crystalline GaN thin films were synthesized in a self-limiting fashion at substrate temperatures as low as 200°C, the lowest reported so far. The novel method named as hollow-cathode plasma-assisted ALD (HCPA-ALD) is by no means limited to the synthesis of GaN only. As the electronics industry, in its bid to uphold Moore's law, moves away from silicon and starts chartering the previously alien territories of nitride semiconductors, low-temperature methods for the fabrication of these materials will no doubt continue to be important for a wide range of potential application areas. The research was published as the front cover article in RSC Journal of Materials Chemistry.
http://dx.doi.org/10.1039/c3tc32418d



Resistive switching

A new way to tame light: The modern telecommunication industry relies heavily on optical modulation, utilizing modulators designed for this purpose to convert electrical data into photons. The efficiency of these optoelectronic modulators may be increased through their integration onto electronic chips, which would boost their performance while scaling down their dimensions for mobile applications. E. Battal, A. Ozcan and A. K. Okyay recently introduced a novel electro-optic modulation method utilizing reversible atomic scale alterations that can be integrated into resistive switching devices. Resistive switching, a non-volatile and reversible property based on atomic scale modifications, is an ideal phenomenon for the improvement of optical modulation efficiency. By using ZnO as the active material, the Okyay Team was able to modulate light in the infrared reflection spectrum of the device between two resistance states. The results of this work can allow the design of alternative modulation schemes such as reconfigurable non-volatile surfaces, imagers and emitters, as well as electro-optic memories. This study thus demonstrates the viability of the resistive switching phenomenon for electro-optic modulation, and has been published as an Inside Front Cover in Advanced Optical Materials, 2 (12), 1149-1154, 2014. DOI: 10.1002/adom.201400209 http://onlinelibrary.wiley.com/doi/10.1002/

A new method to increase drug delivery to cancer cells



Assoc. Prof. Mustafa Özgür Güler, Asst. Prof. Ayşe Begüm Tekinay and their students at Bilkent University Institute of Materials Science and Nanotechnology developed a new drug delivery platform for anticancer drugs. The work supported by TÜBA GEBİP and TÜBİTAK was published at the Faraday Discussions, which is a journal of Royal Society of Chemistry. The manuscript was published as an invited article and highlighted in the cover of the issue. The manuscript was also one of the most downloaded 10 articles in the year of 2013 on the web site of the journal.

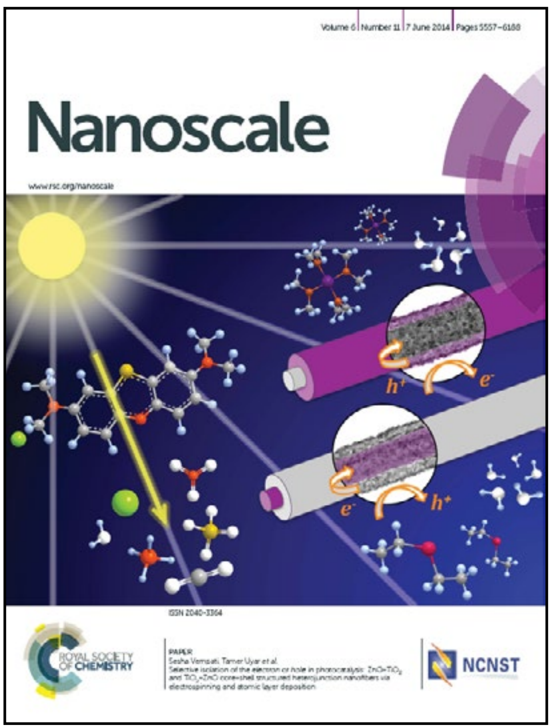
In this work, peptide molecules were integrated into the liposomal drug delivery platforms to enhance cellular uptake of the anticancer drugs. Liposomes can be used to deliver hydrophilic and hydrophobic drugs due to their structural similarities with cell membrane. Peptides conjugated to a fatty acid can be noncovalently incorporated inside liposomal membrane due to hydrophobic interactions. MCF7 breast cancer cells were treated with anticancer drug containing liposomal systems and enhanced drug activity was observed with peptide integrated liposomes.

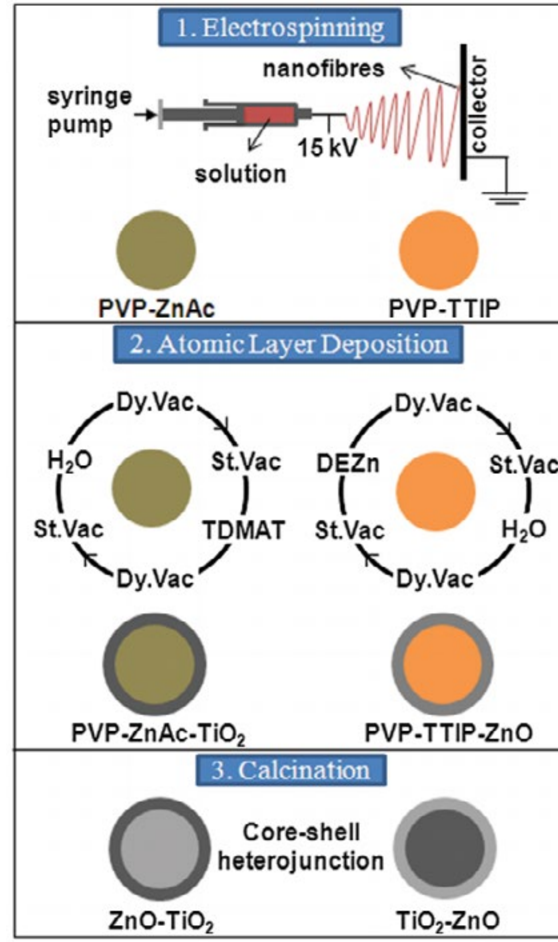
Faraday Discussions only publishes invited articles and these articles are discussed in a meeting. These discussions are also published along with the articles.

Photocatalysis: An economic and viable environmental remedy

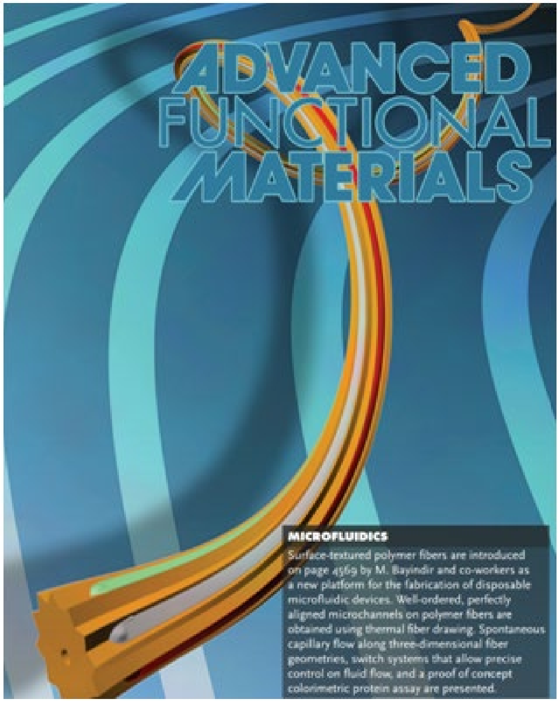
Humans have had an inordinate effect on their environment since the Industrial Revolution, and the pollution of soil and water ecosystems with organic contaminants has become a significant problem in the past few decades. Photocatalysis is a particularly promising method for the removal of these pollutants, and involves the use of a semiconductor catalyst that is activated by sunlight. This semiconductor must ideally possess features that allow it to reach high reaction rates with a wide variety of potential pollutants, which often necessitates a specific set of chemical and electronic properties, as well as high surface areas.

Dr. Tamer Uyar's research group has recently developed an electrospinning-based process that allows the production of low-cost nanostructured semiconductors with features highly conductive for use in pollutant removal. Conducted in tandem with Dr. Necmi Bıyıklı's group, the study in question details the properties of a smart core-shell nanofibrous material, fabricated by coating an electrospun semiconductor nanofiber with a secondary semiconductor layer via atomic layer deposition. This configuration allows the combination of two powerful photolytic catalysts, such as ZnO and TiO2, for effective pollutant removal under sunlight. This material combination is also effective in that it directly illustrates the roles of each charge carrier (electron and hole) in the photocatalysis process – an effect that had so far remained unexplored in the literature. Uyar and Bıyıklı groups' findings suggest that electron-mediated degradation processes are more effective in degrading organic dyes in aqueous media.The results of this study help to design future generation catalysts and a complete study is published as an Outside Front Cover in Nanoscale, 6 (11), 5735 – 5745, 2014. (DOI: 10.1039/C3NR06665G)





Lab-on-a-wire: UNAM researchers drive channels through the edges of wires



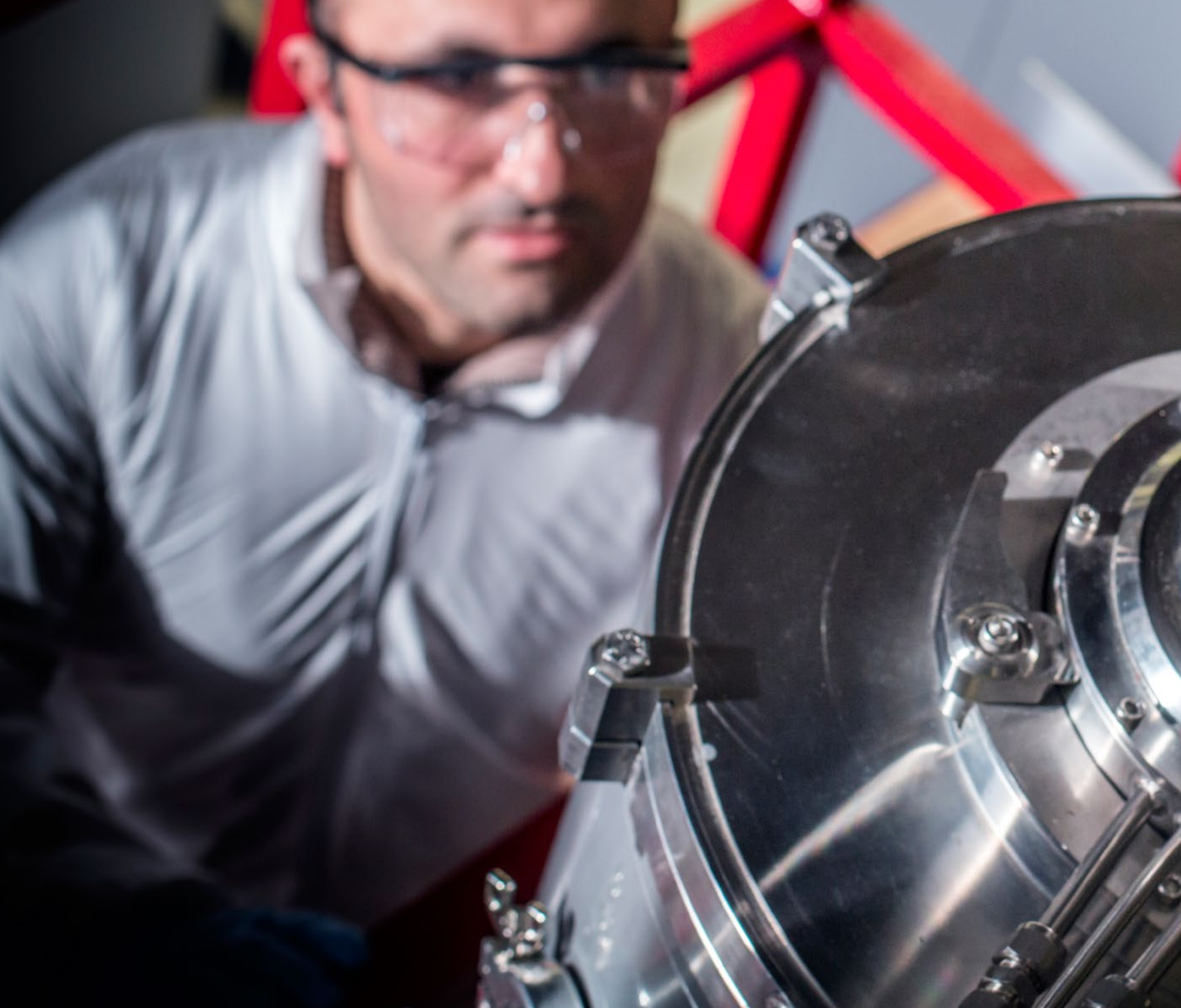
Running an analytical laboratory is no small feat – depleted supplies, broken equipment, difficulties in data interpretation and the stress of having to deliver results on time all make it a far cry from the lofty desk-job it first appears to be. The prospect of designing simple, disposable test kits for standard diagnostics is coveted by biologists and physicians alike, and may even allow individuals to regularly check for potential illness before contacting a medical facility – a substantial boon, given the importance of early diagnosis. An ideal detection product would be much like a pregnancy test: add a drop of blood, urine or saliva; red means sick, green means not.

Such disposable kits aren't in the realm of sci-fi fantasy: Microfluidics allows the enterprising engineer to design laboratories in the miniature, where each chamber in a fingernail-sized chip contains a reactant to be added to a sample (of bodily fluids, cell lysates or any other analyte) as it flows through a microscopic channel. Fast, cheap and consistent, lab-on-a-chip approaches easily have the potential to surpass their macro-scale counterparts, which often require their analytes and buffers to be in volumes greater by orders of magnitude.

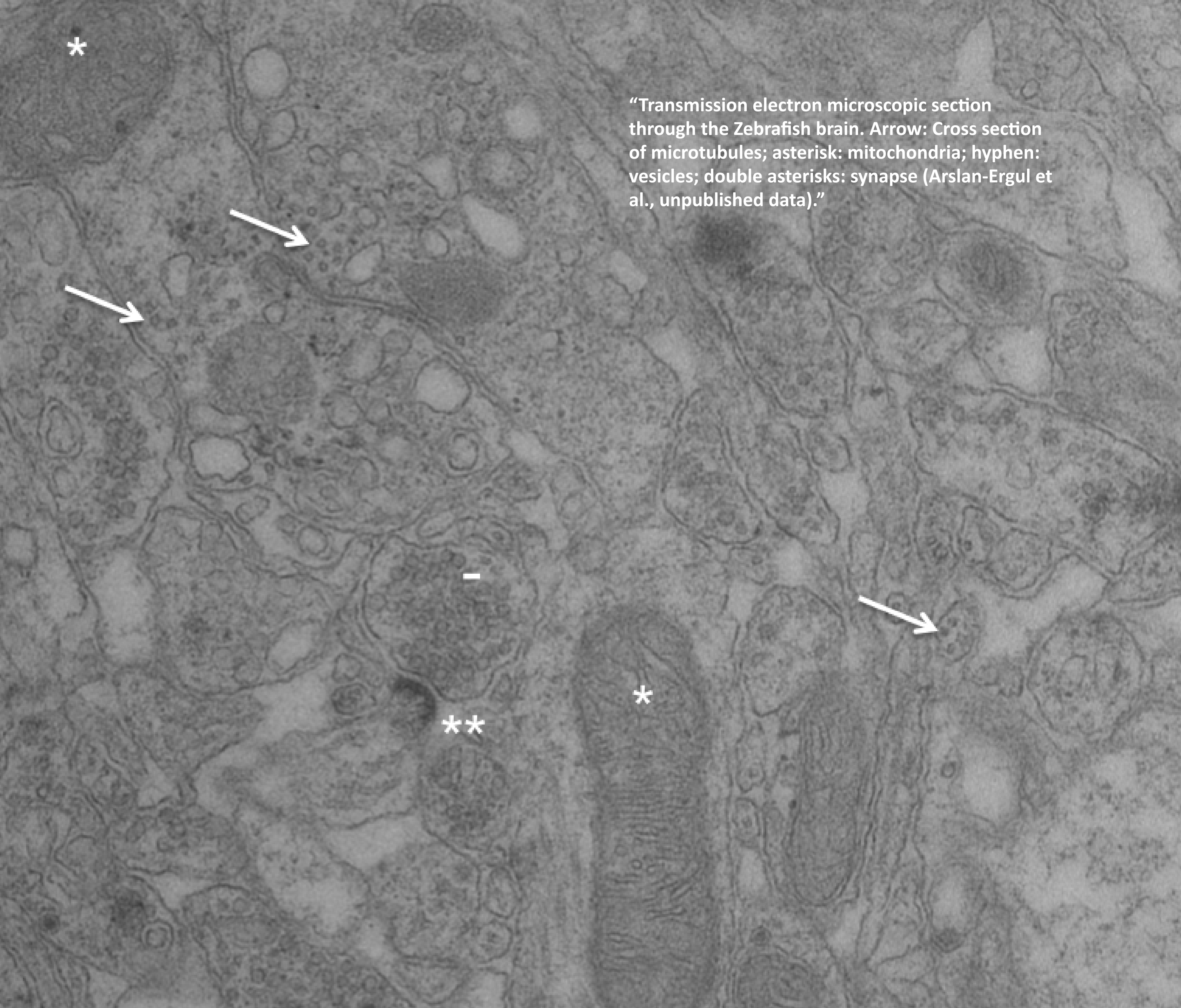
UNAM research team, led by Prof. Mehmet Bayındır, has recently added a new trick to the field of microfliuidics: Miniature channels that run on the edges of polymer fibers, transforming these age-old structures into a veritable new medium for microfluidics applications.

The team's way of synthesizing microwires takes no futuristic-looking, excruciatingly precise assembly mechanism – the entire process starts with a large chunk of Teflon. Fashioned into a rod, the Teflon core is then wrapped with a shell of polyetherimide, heated to melt the layers together, carved into a cylinder with twenty notches along the edges, slowly fed into a furnace, and pulled – and therein lies the crux of the method. As the polymer composite is heated, it becomes ductile and yet retains its notched shape, allowing its size to be reduced without compromising its unique morphology. Once the drawing is complete, the resulting fiber can be fed again to the drawing tower, shrinking down in each iteration until micro- or nanoscale nanowires are obtained.

Further modification of the fibers allows the production of more complex structures, two of which were fabricated to demonstrate the efficiency of the material in replicating biological assays, with HSA and bromophenol blue, a dye that changes color upon binding with HSA. Simple but versatile, the team's microfiber arrays can be connected in various configurations to perform assays of any complexity, and further modifications to the microfiber structure may be employed to meet the specific needs of more demanding reactions. Bayındır group, meanwhile, is focusing its efforts on advancing their size-reduction technique not just for microfluidic devices, but also to create novel nano- and micromaterials to be used in photonics, optoelectronics, biosensors and functional materials of any other bent. Their work is supported by TUBITAK under project no. 110M412 and the European Research Council under the European Union's Seventh Framework Programme (FP/2007–2013)/ERC Grant Agreement no. 307357. (DOI: 10.1002/adfm.201400494)



RESEARCH GROUPS

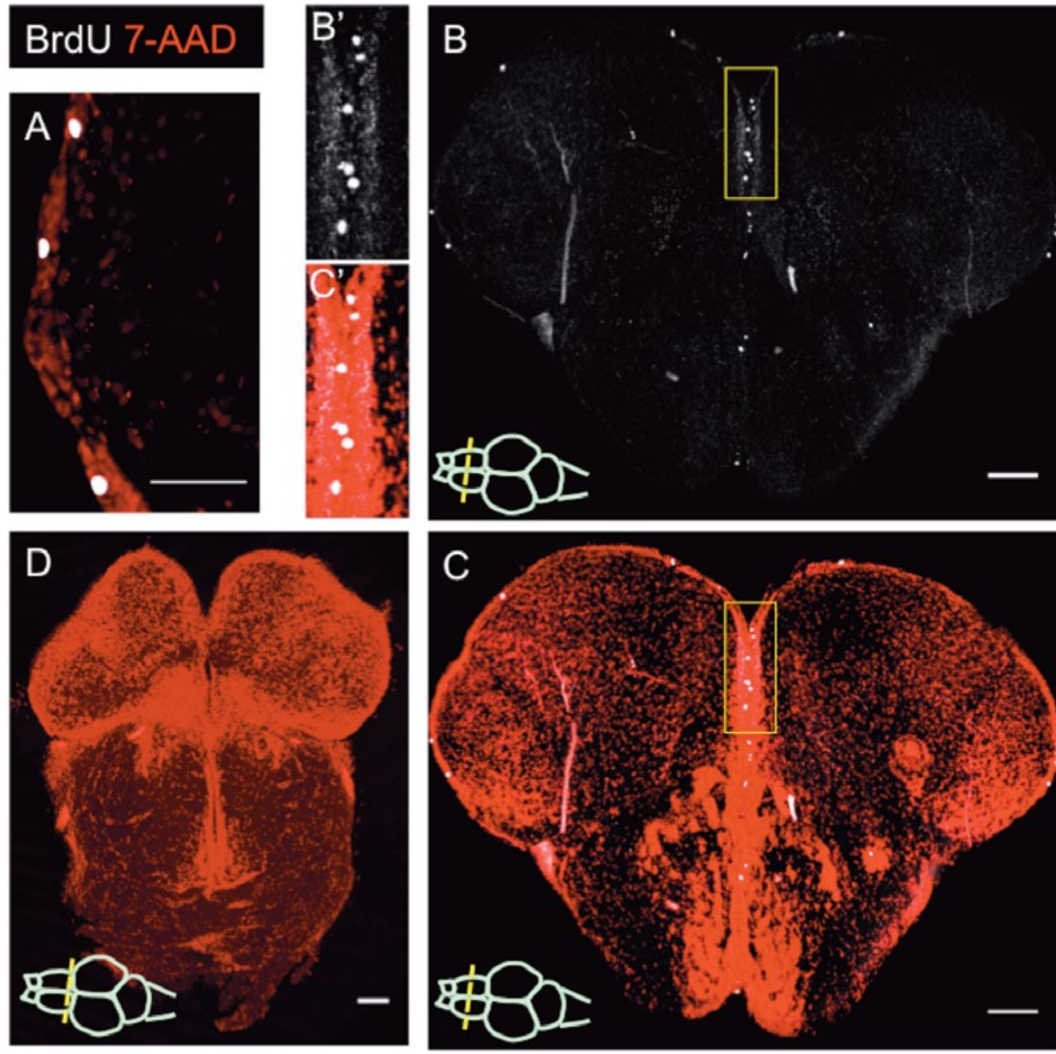


"Transmission electron microscopic section through the Zebrafish brain. Arrow: Cross section of microtubules; asterisk: mitochondria; hyphen: vesicles; double asterisks: synapse (Arslan-Ergul et al., unpublished data)."

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.

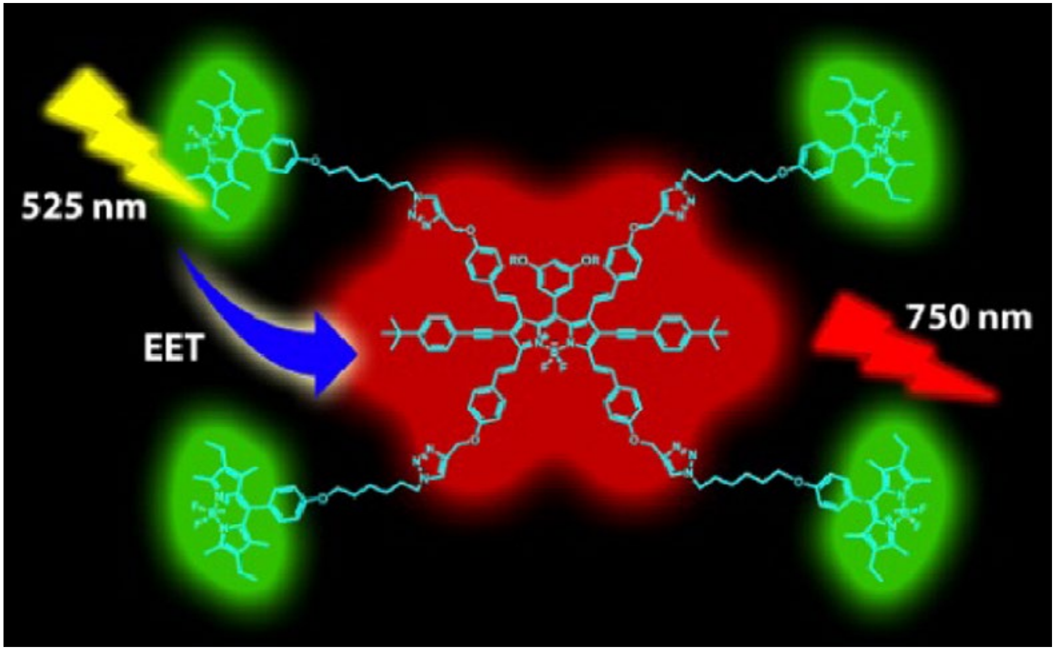


Supramolecular Chemistry and Chemical Nanotechnology

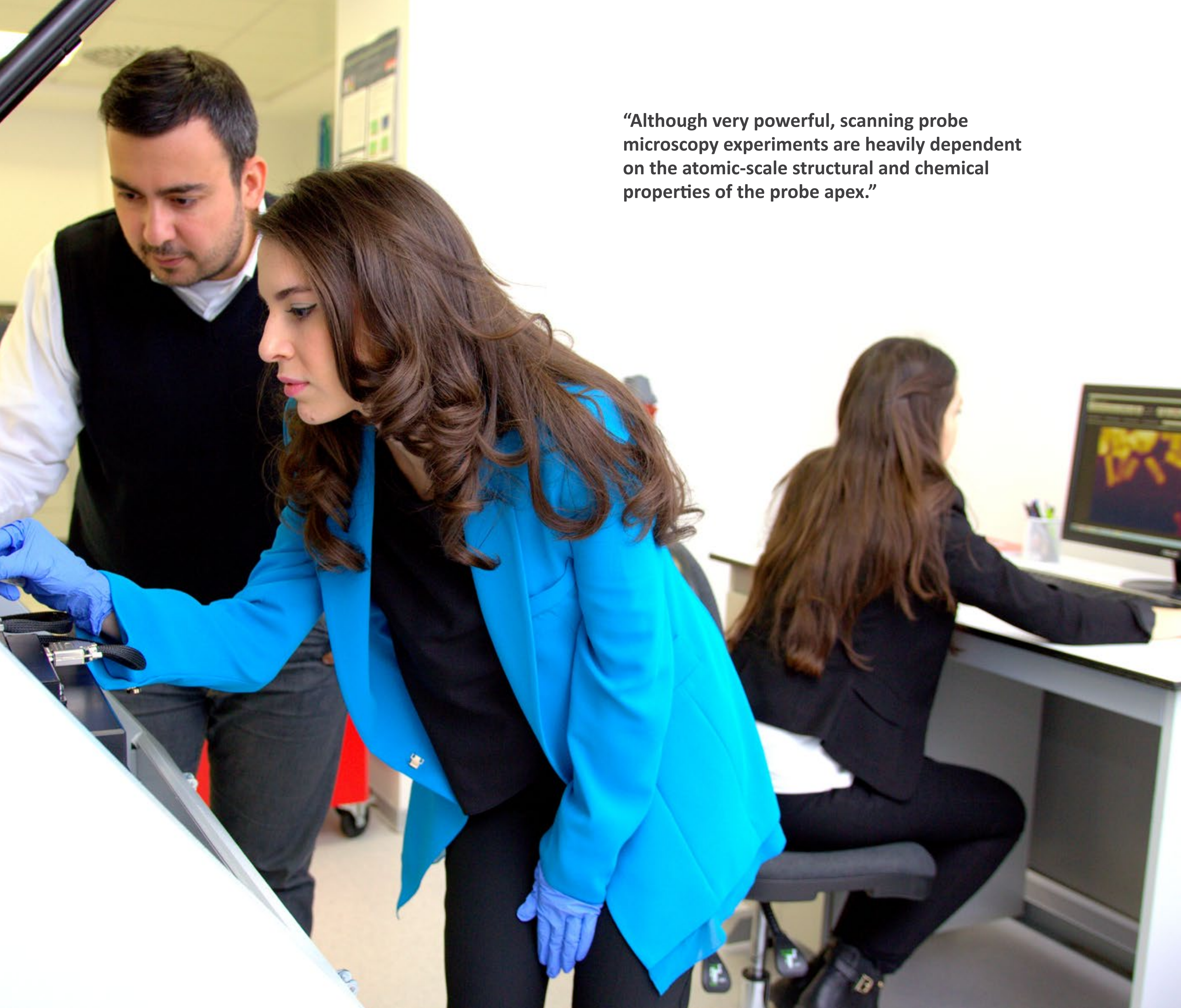
Rational design of molecular or supramolecular structures with emergent functionalities is the primary target of our research efforts. To that end, we are trying to find practical applications for molecular logic gates, develop autonomous activation protocols for biologically active organic compounds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

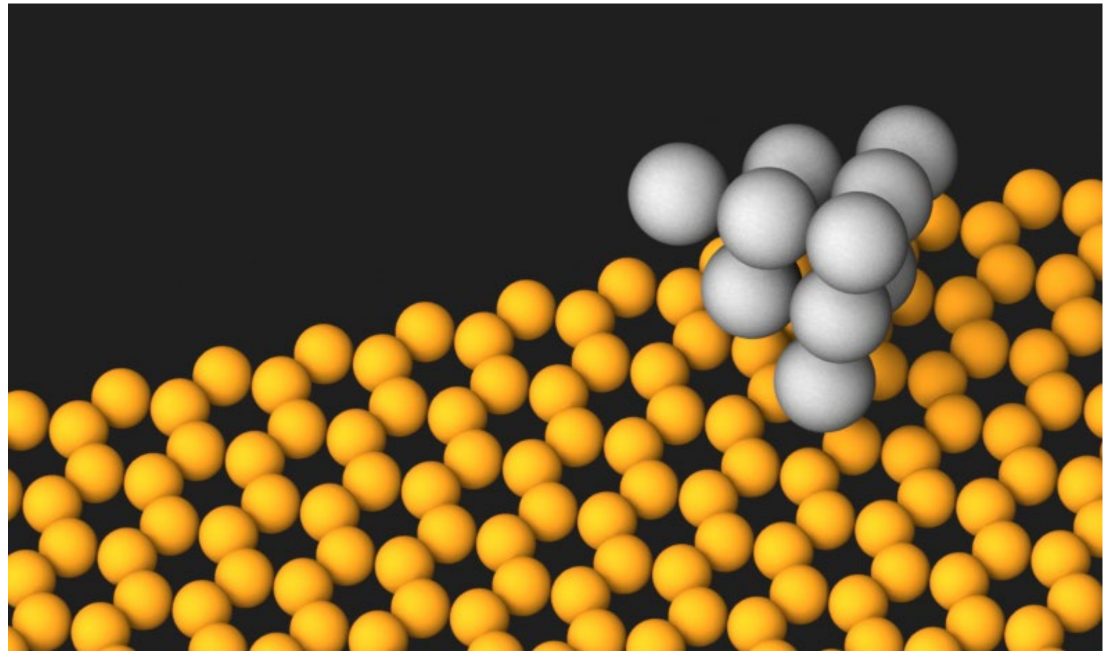


“Although very powerful, scanning probe microscopy experiments are heavily dependent on the atomic-scale structural and chemical properties of the probe apex.”

Dr. Mehmet Z. Baykara

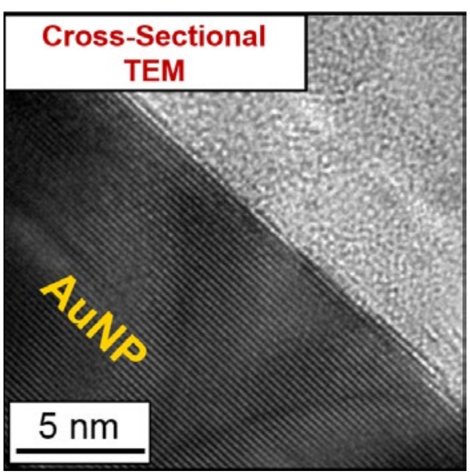
Scanning Probe Microscopy (SPM)

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.

Mechanochemistry

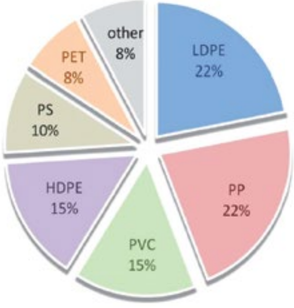
In our research group, we develop new materials and methods to efficiently convert mechanical energy to chemical energy.

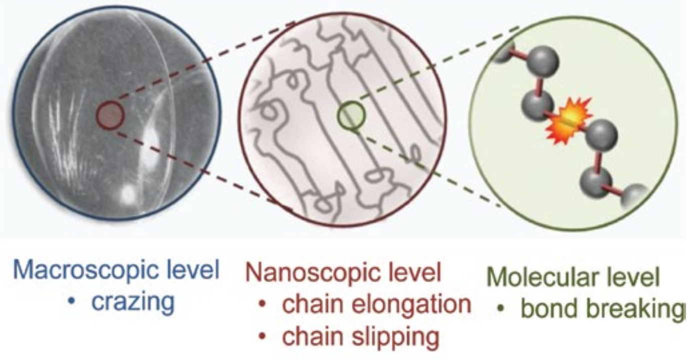
Mechanochemistry

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.

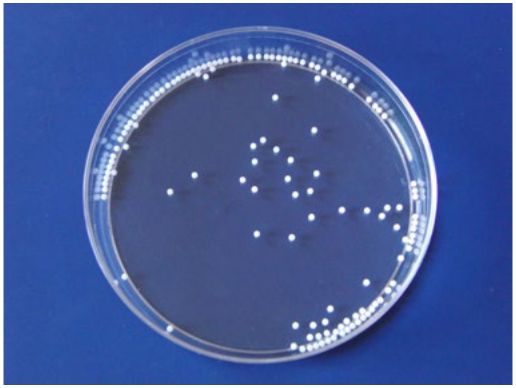
Triboelectricity of Polymers

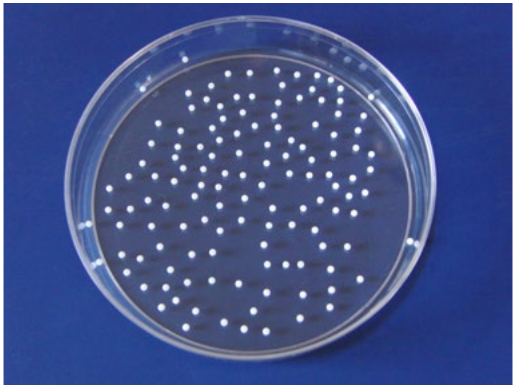
Polymers are the most encountered materials in our everyday life with a rapid growth of utilization. The versatility of the uses of polymers, from spacecrafts to ordinary plastic bags, the variety of chemical and physical properties and their dependence on environmental conditions hinder a better understanding 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.

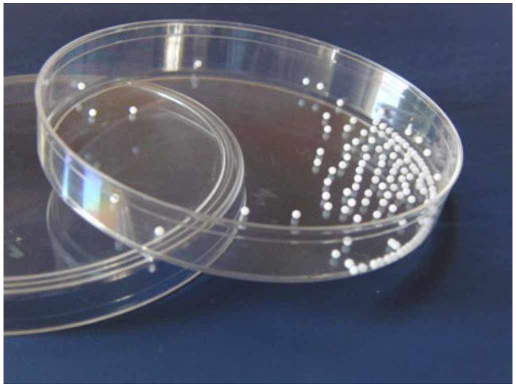
It is a millennia-old problem to understand the electrification of insulators. Our group contributes largely in finding out solutions for this question on the fundamental basis. Moreover, we develop new methods based on this knowledge to mitigate polymer electrification. These methods can be useful in 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

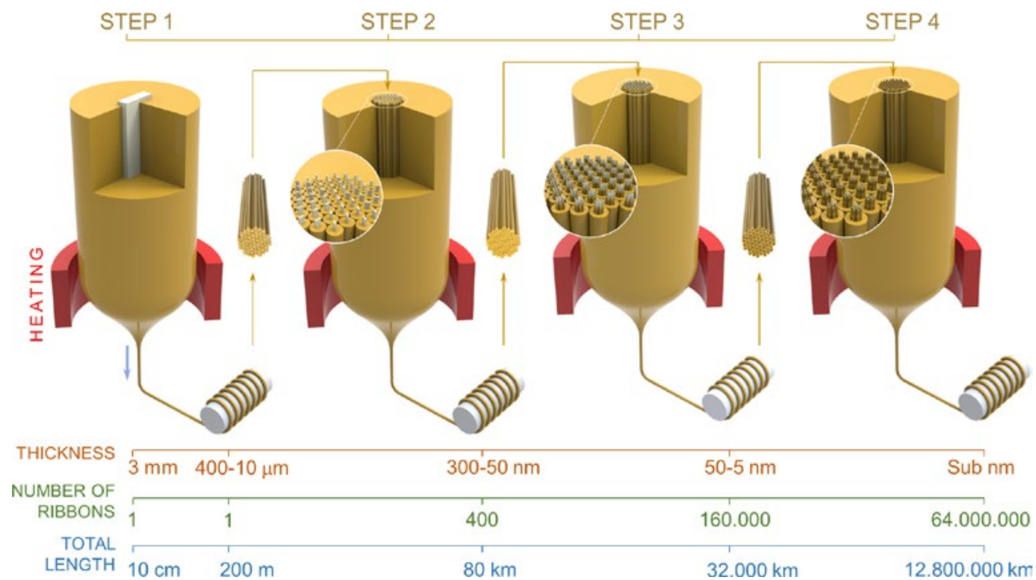
Nanowires constitute an exciting research field in nanotechnology, regarding their unprecedented characteristics compared to their bulk counterparts. Although fabrication and characterization of nanowires are quite well-established, serious problems persist in large scale integration of nanowires into 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

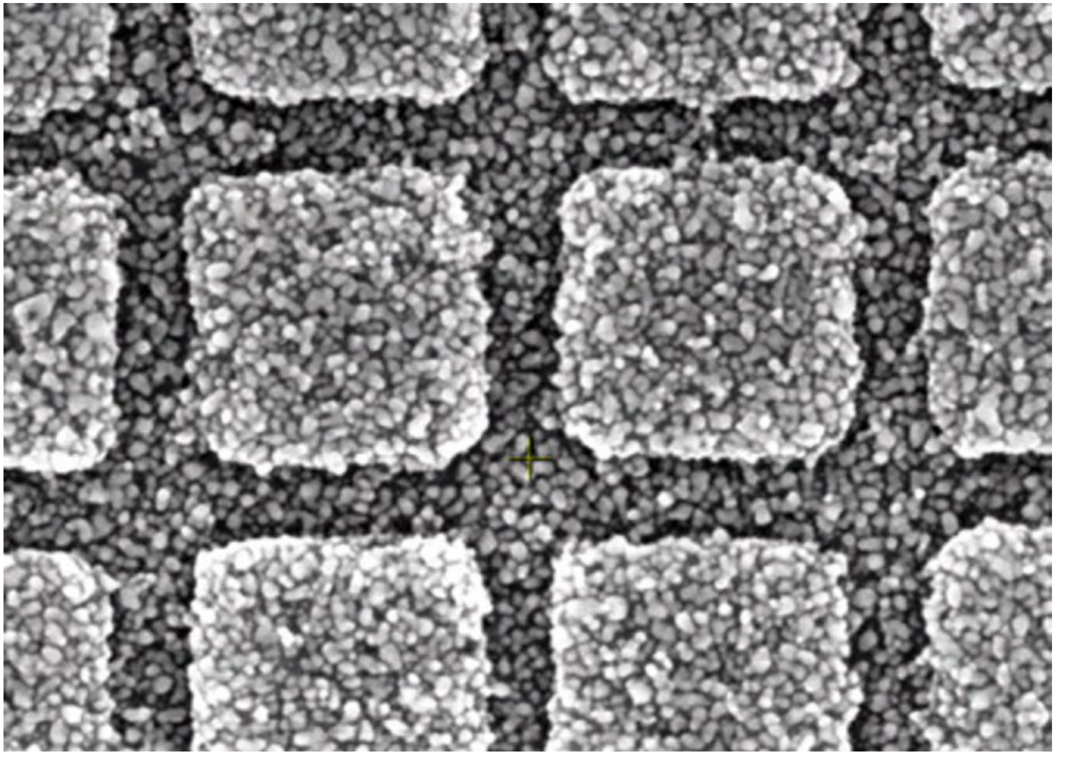
Thanks to the ever continuing development of microelectronics, we now live in an age where almost everyone carries a powerful computer, be it a mobile phone or a tablet. We use electromagnetic design and nanoscale structuring to produce surfaces and systems that enable Plasmon resonance based imaging 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.

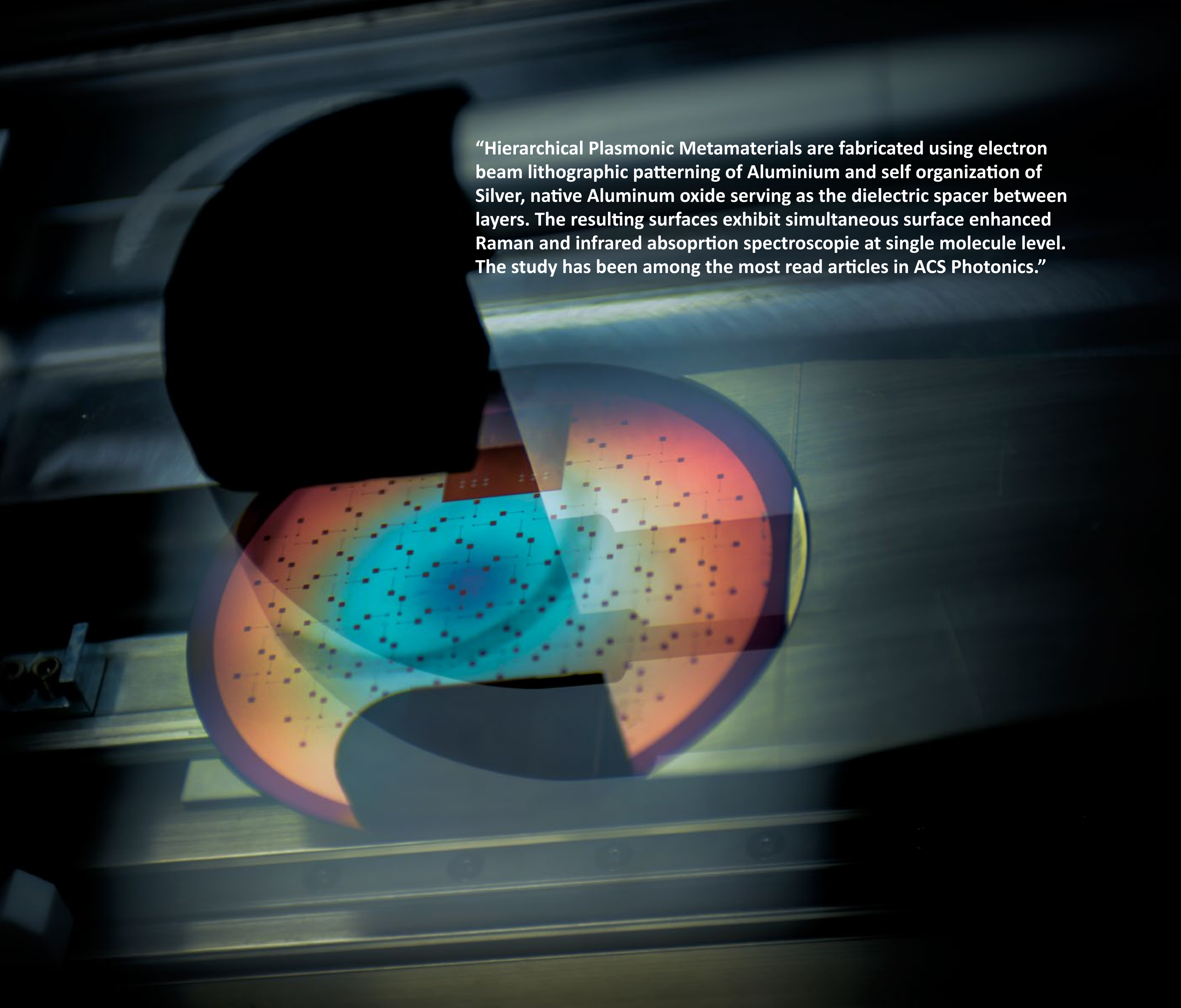
Label-free imaging beyond the diffraction limit

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.





"Hierarchical Plasmonic Metamaterials are fabricated using electron beam lithographic patterning of Aluminium and self organization of Silver, native Aluminum oxide serving as the dielectric spacer between layers. The resulting surfaces exhibit simultaneous surface enhanced Raman and infrared absoprtion spectroscopie at single molecule level. The study has been among the most read articles in ACS Photonics."

Dr. Hilmi Volkan Demir

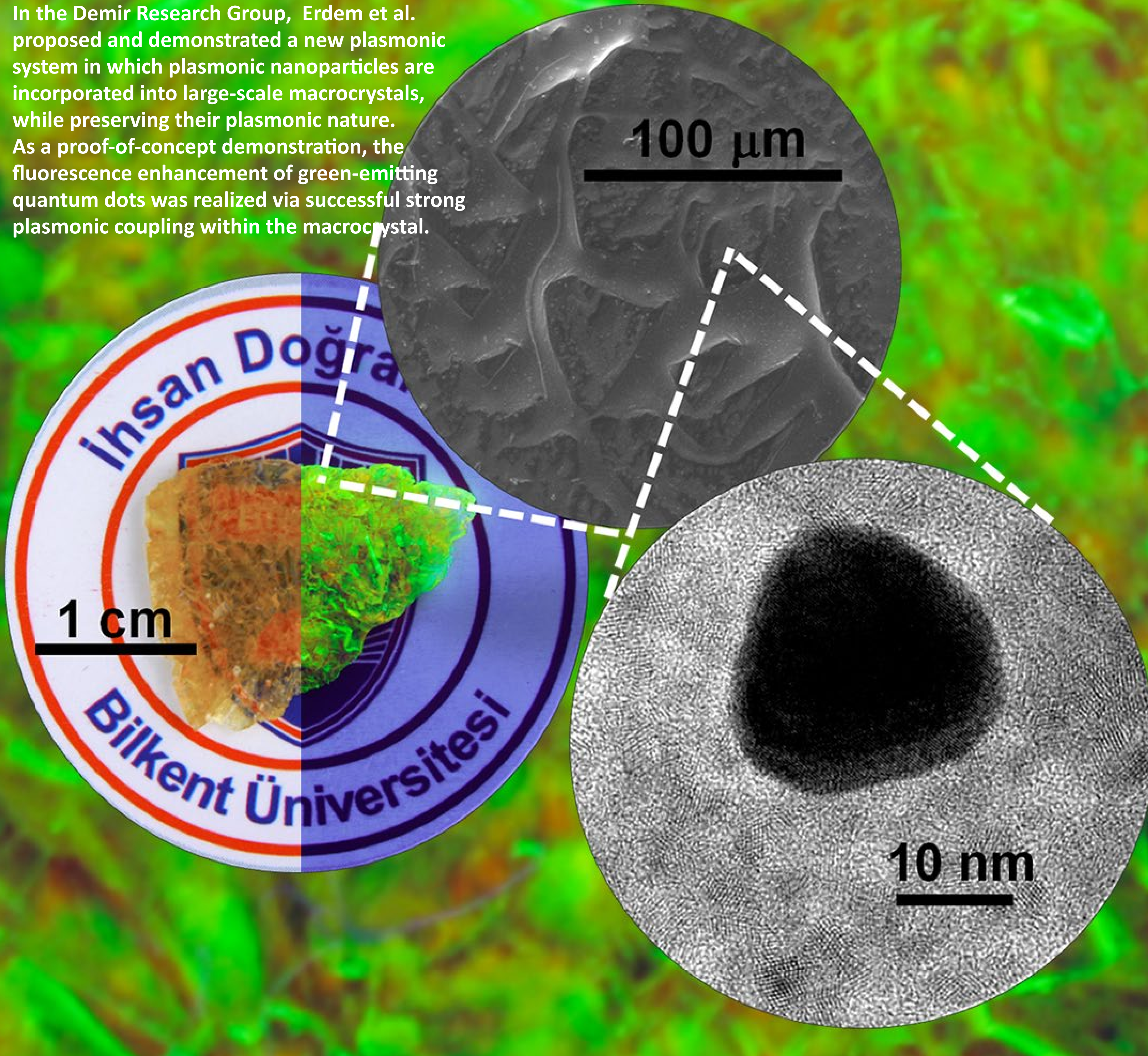
Devices & Sensors Research Group

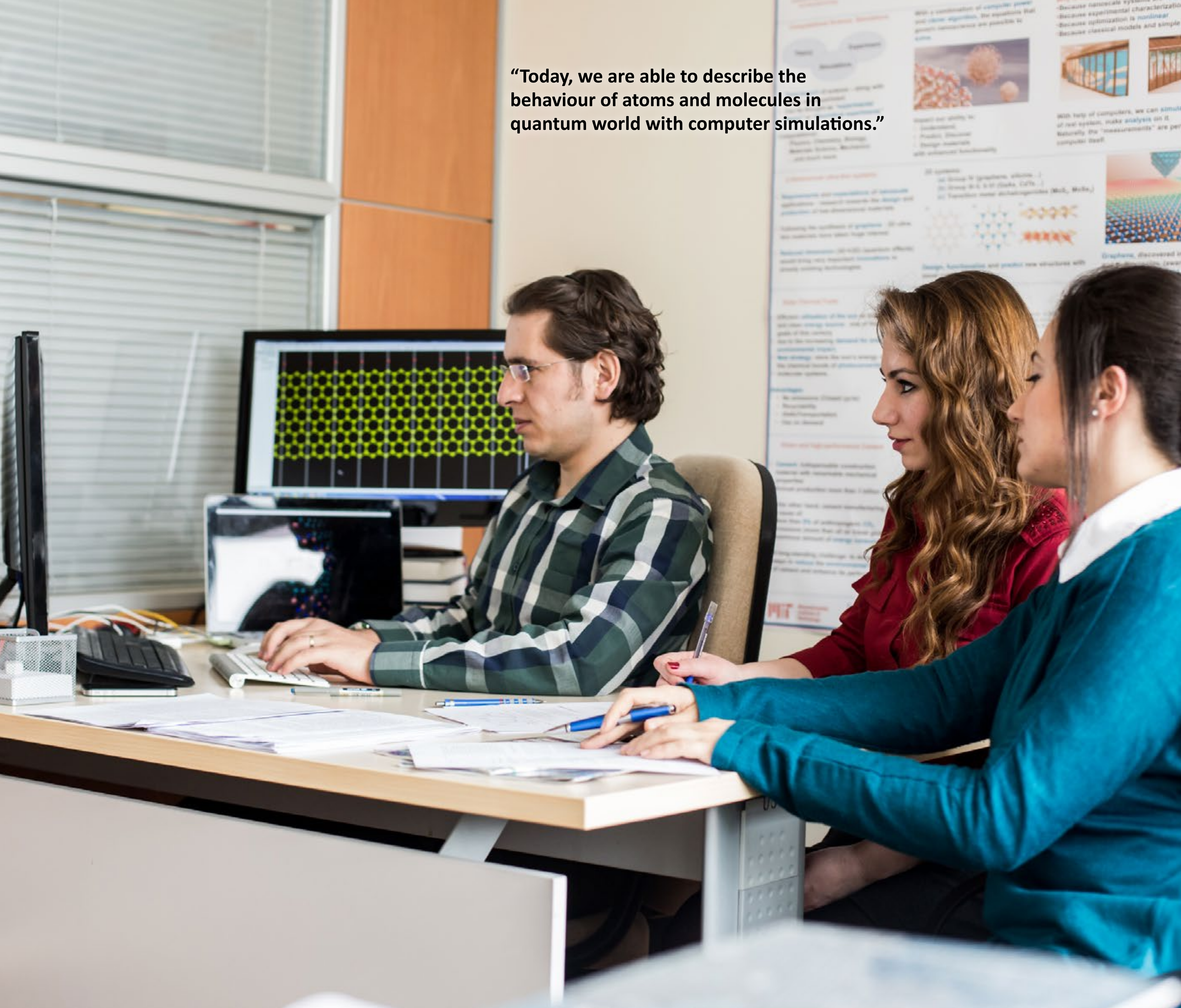
The Demir Research Group is working on innovative nanophotonic and optoelectronic materials, devices, and platforms, embedded with nanoscale functional structures especially focusing on the problems of high-quality semiconductor LED lighting, FRET-based light generation and harvesting, energy transfer phenomena, and nanocrystal optoelectronics, and plasmonics, 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 developed the understanding of using spectrally narrow emitters in LED lighting for high efficiency and quality, and transformed the knowledge of spectrally sharp discontinuous color conversion, which is now being adapted in some commercial products in industry. Among the major scientific accomplishments is the demonstration of the feasibility of high-quality energy-saving white light sources of LEDs with tuneable photometric properties. One important technological breakthrough resulting from the Demir's Group LED research is the demonstration of the record high photometric performance, ever reported for LEDs to date. This work appeared in a review in Nano Today and in a letter in Nature Photonics.

Another important scientific advancement enabled by the Demir Group's research is the largest color-converting nanocrystal-based freestanding sheets (over 50 cm by 50 cm) achieved for LEDs and displays to date, published in Nano Letters. Previously the largest possible dimensions were only few cm's. These flexible nanocrystal sheets enable remote color conversion and enrichment over very large areas. Such nanocrystal membranes can be used on three-dimensional surfaces of smart windows/walls and building facades for lighting. These LED platforms hold great promise for future lighting and display applications (e.g., LED TV) with their highly adjustable quality properties, presenting commercially important added value and interest. These and related results have recently appeared in a number of top-tier publications including Nano Letters, ACS Nano and Advanced Materials.

In the Demir Research Group, Erdem et al. proposed and demonstrated a new plasmonic system in which plasmonic nanoparticles are incorporated into large-scale macrocrystals, while preserving their plasmonic nature. As a proof-of-concept demonstration, the fluorescence enhancement of green-emitting quantum dots was realized via successful strong plasmonic coupling within the macrocrystal.





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

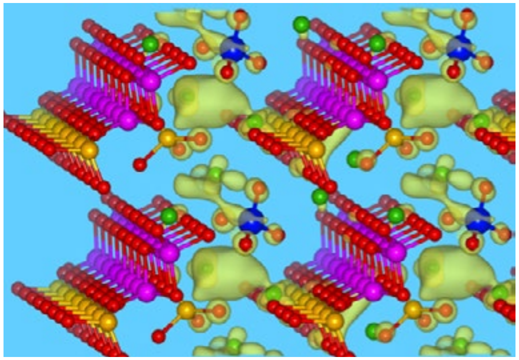
Dr. Engin Durgun

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.

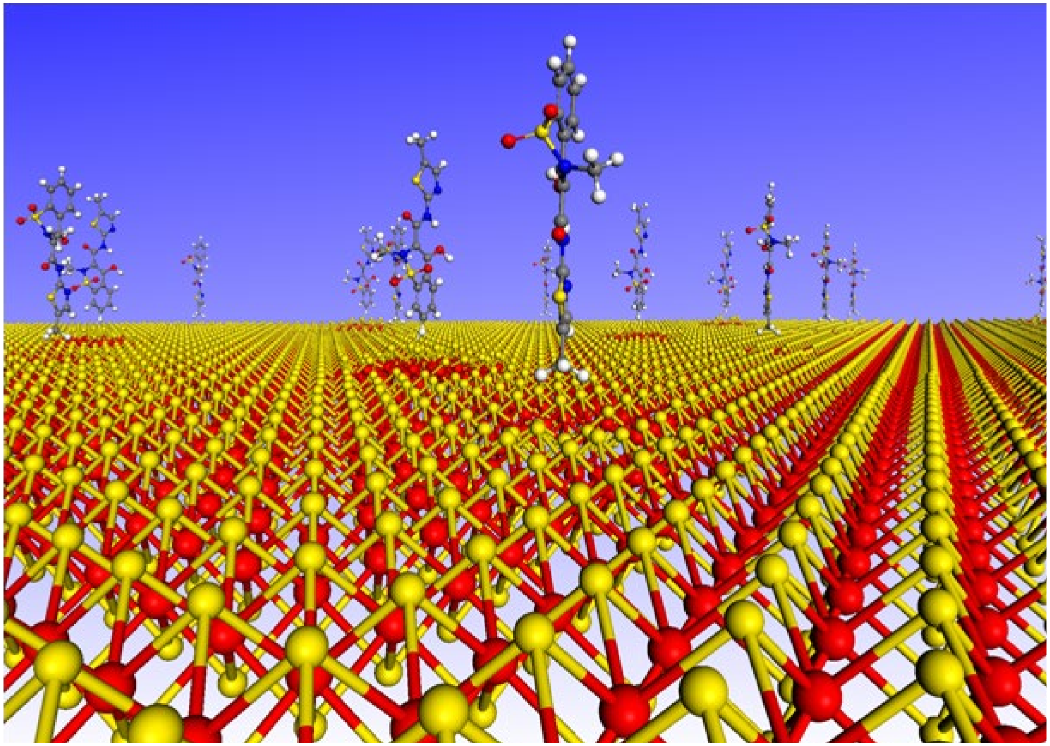
Green and high performance cement

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.



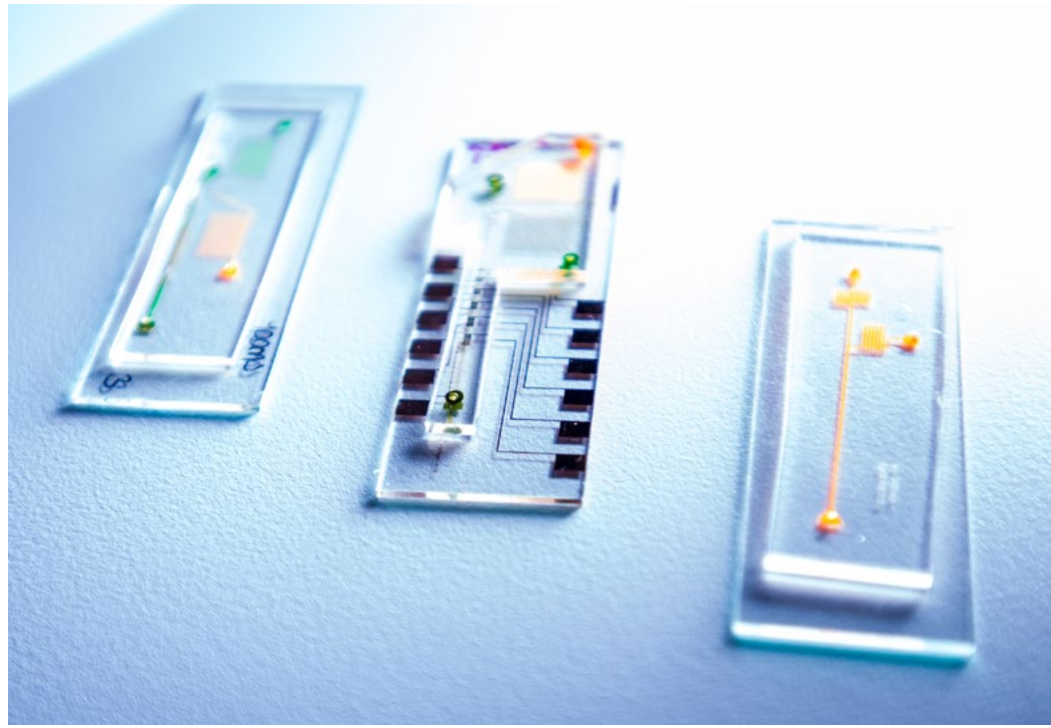
Solar-thermal fuels

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

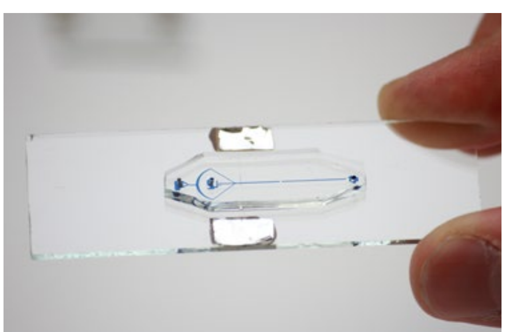
Micro/Nanofluidics and Lab on a Chip Systems

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.

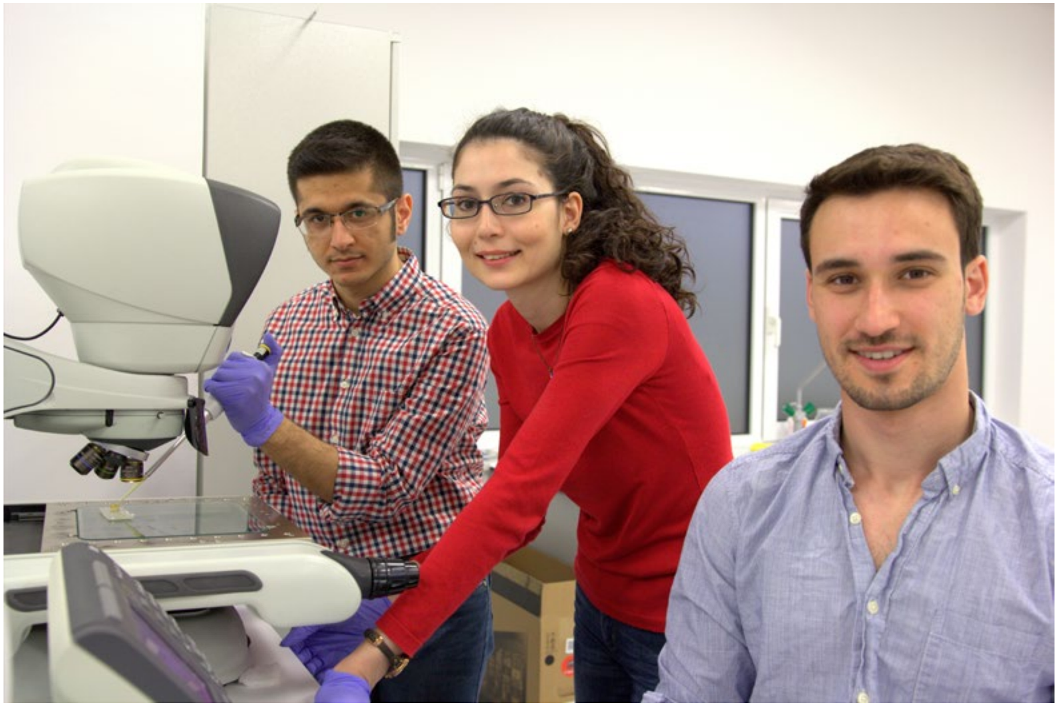
Dr. Yegân Erdem

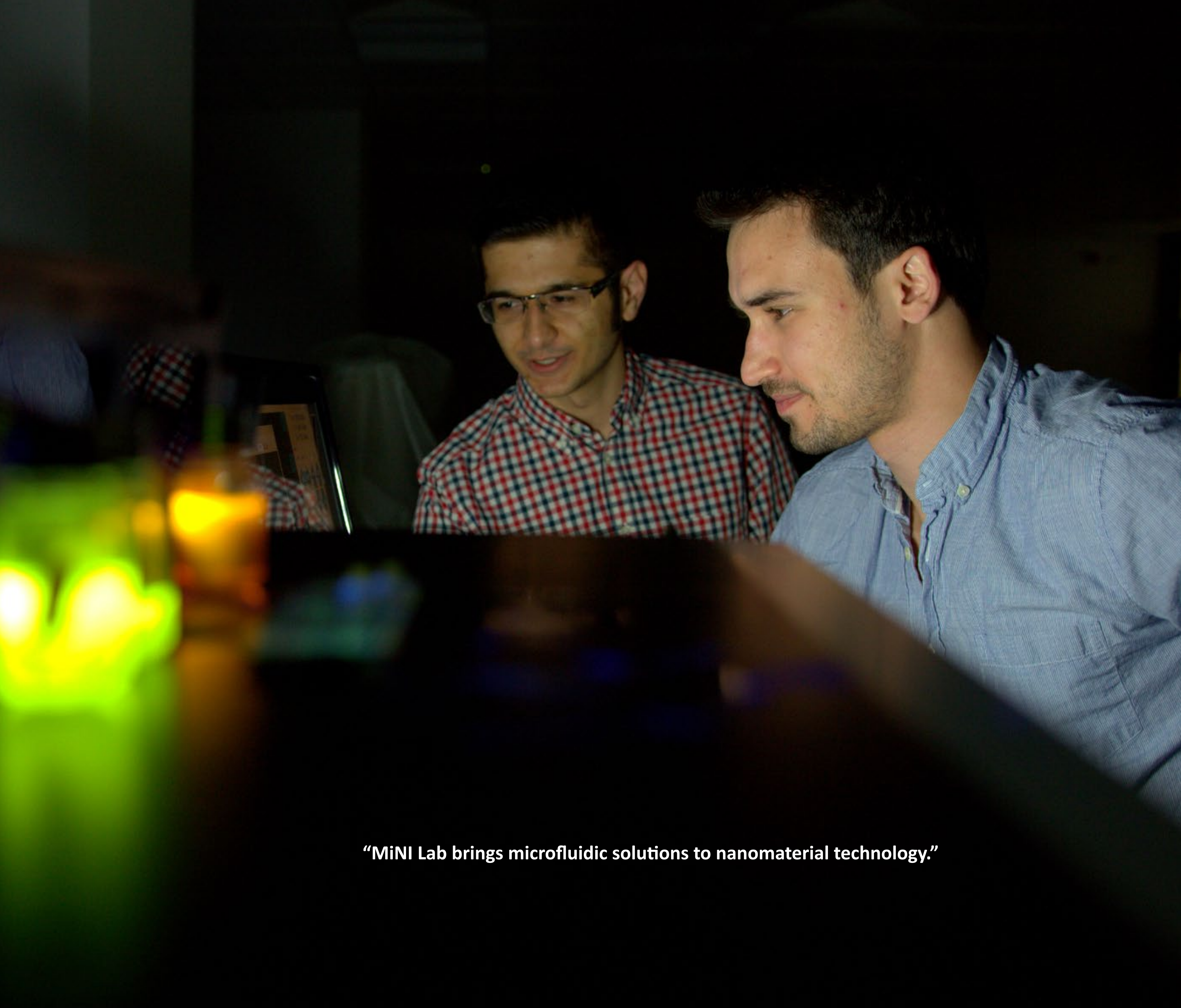
Micro and Nano Integrated Fluidics (MiNI) Lab

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.

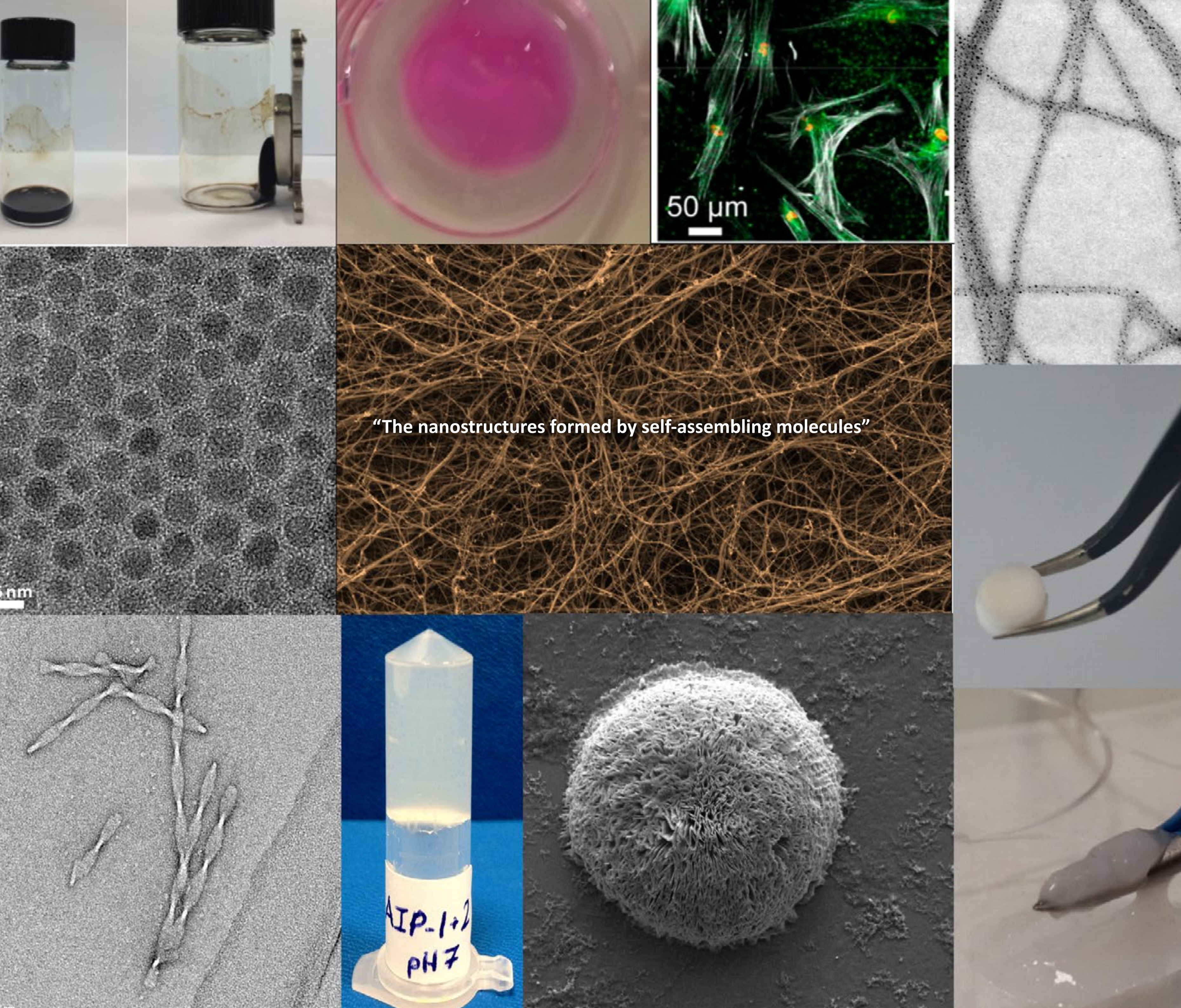
MiNI Lab is a research group that brings microfluidic solutions to nanomaterial technology. Nanomaterials such as nanoparticles, nanorods or nanowires, have unique properties that highly depend on their size; therefore it is crucial to be able to perform synthesis reactions with superior control over 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.”


50 µm
"The nanostructures formed by self-assembling molecules"
AIP-1+2
pH 7

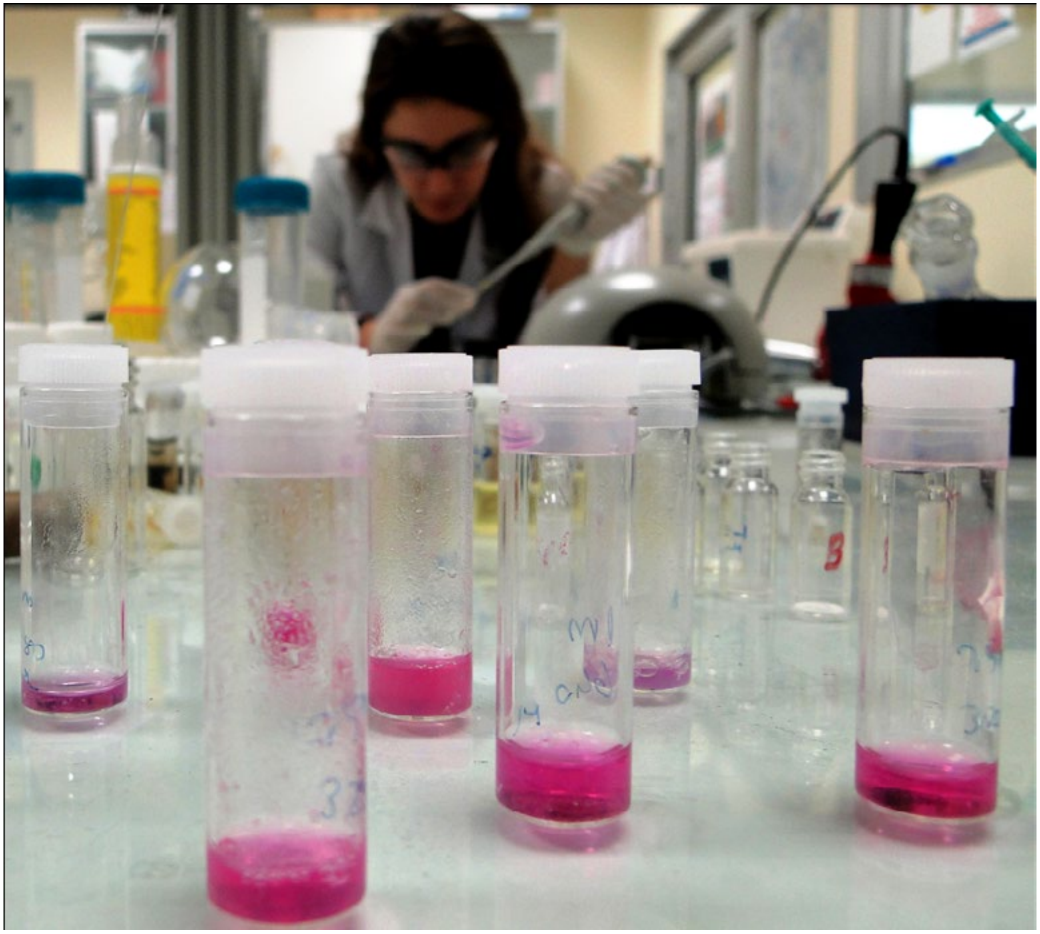
Dr. Mustafa Özgür Güler

Biomimetic Materials Laboratory

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 into the biomedical applications are main motivation of our studies. Research at the Biomimetic Materials Laboratory (BML) is based on discoveries at the interface of chemistry, molecular biology, and materials science. BML group incorporates diverse scientific disciplines and collaborates with several 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 supramolecular 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.



Nanoelectromechanical Systems (NEMS)

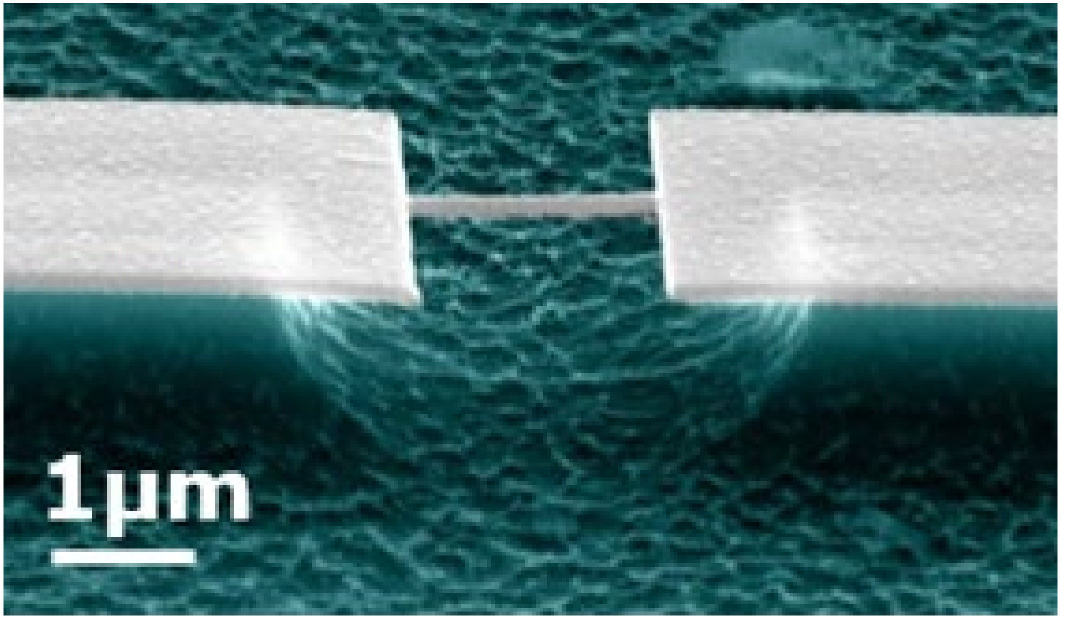
Dr. Selim Hanay

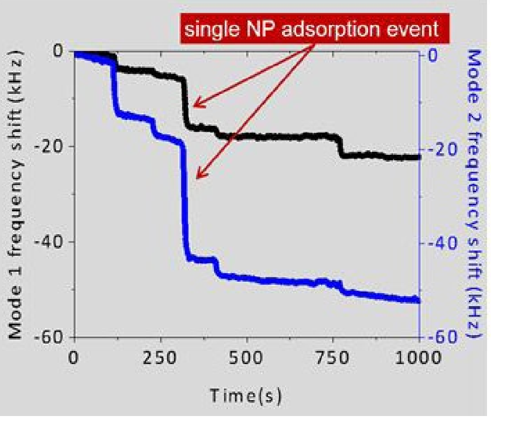
We are engineering ultra-small mechanical machines to develop novel sensor technologies for biological and environmental problems. Thanks to their miniscule size, these sensors are extremely sensitive to physical changes. We are developing NEMS-based mass spectrometry systems that enables chemical analysis 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

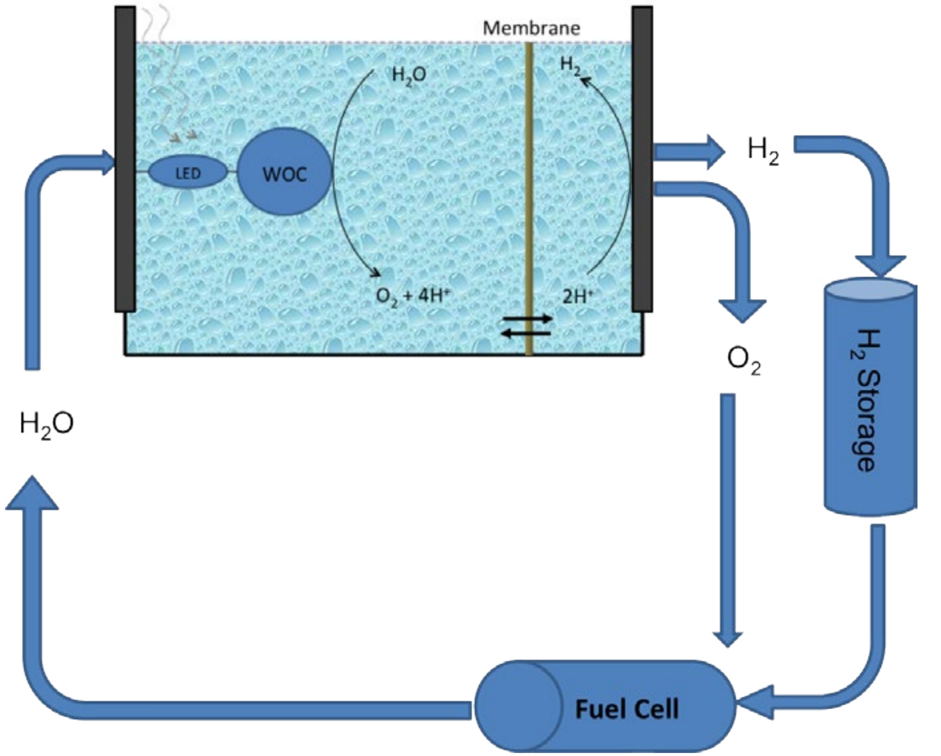
Solid adsorbents that could physically adsorb hydrogen are one of the most promising class of materials since they are robust at extreme conditions and their regeneration energy is negligible. Preparation and investigation of solid adsorbents that exhibit high performance at ambient conditions is the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

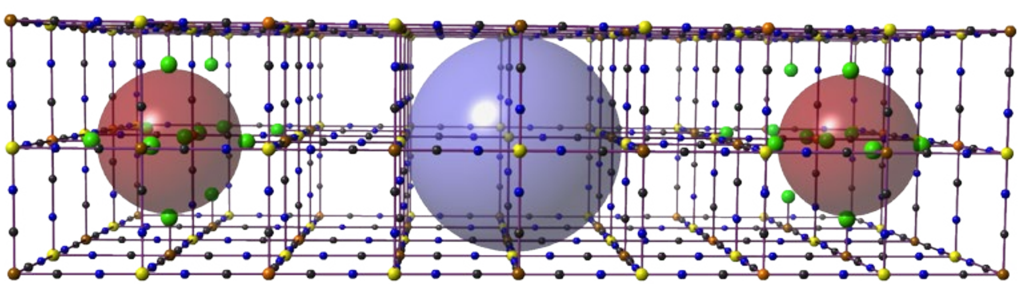
Coordination Compounds for Water-oxidation Catalysis – Artificial Photosynthesis

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

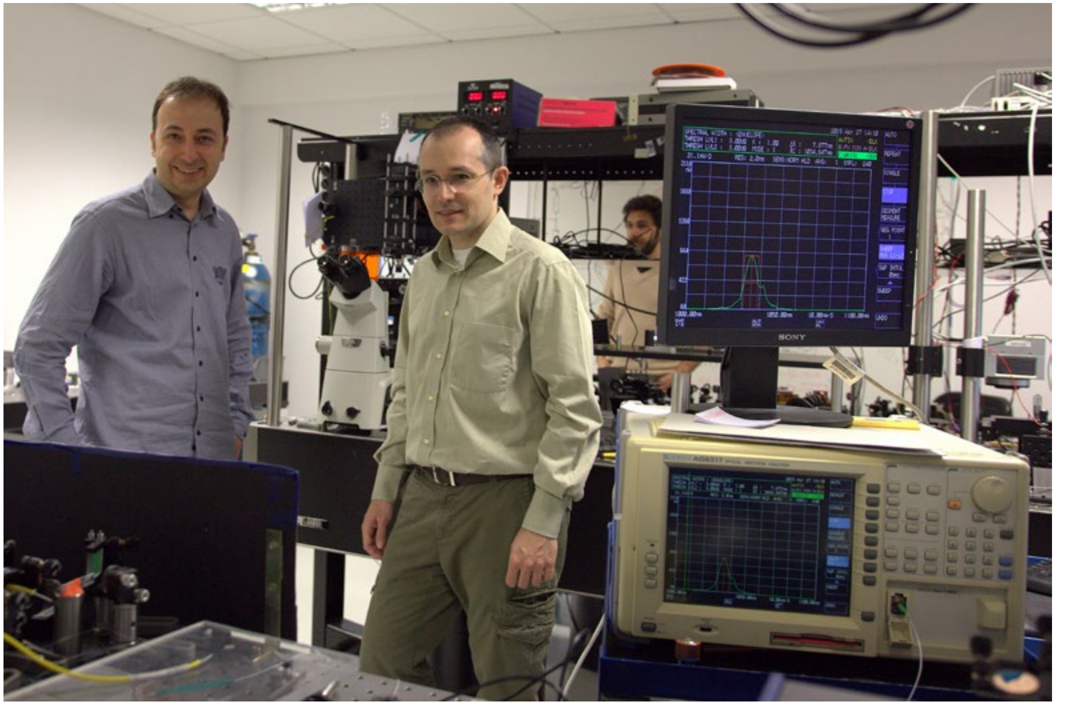
Laser-induced Fabrication of Self-organized Nanostructures

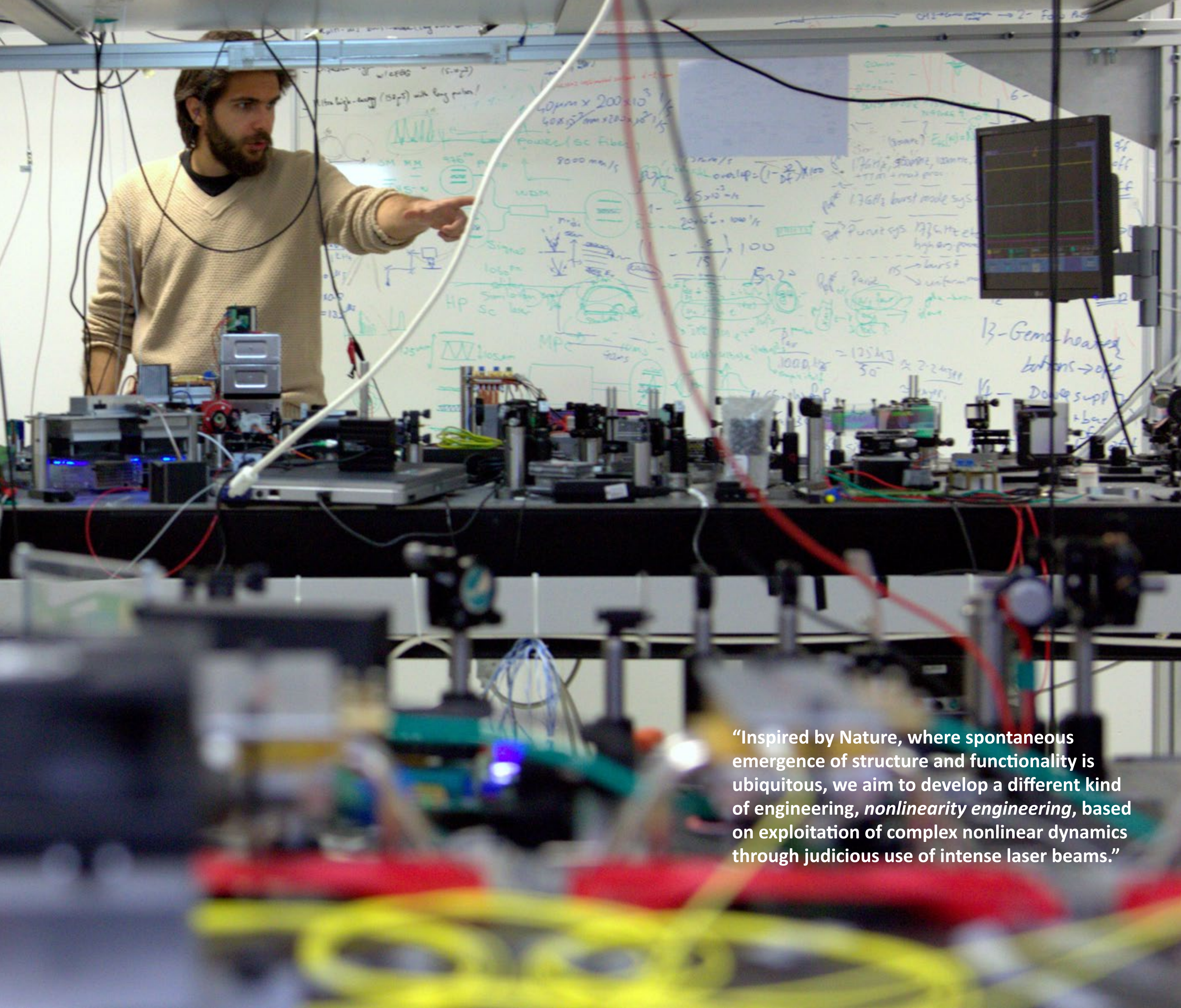
Control of matter via light has always fascinated mankind; not surprisingly, laser patterning of materials is as old as the history of the laser. We have recently demonstrated a technique, Nonlinear Laser Lithography (NLL), that allows laser-controlled self-organized formation of metal-oxide nanostructures 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.





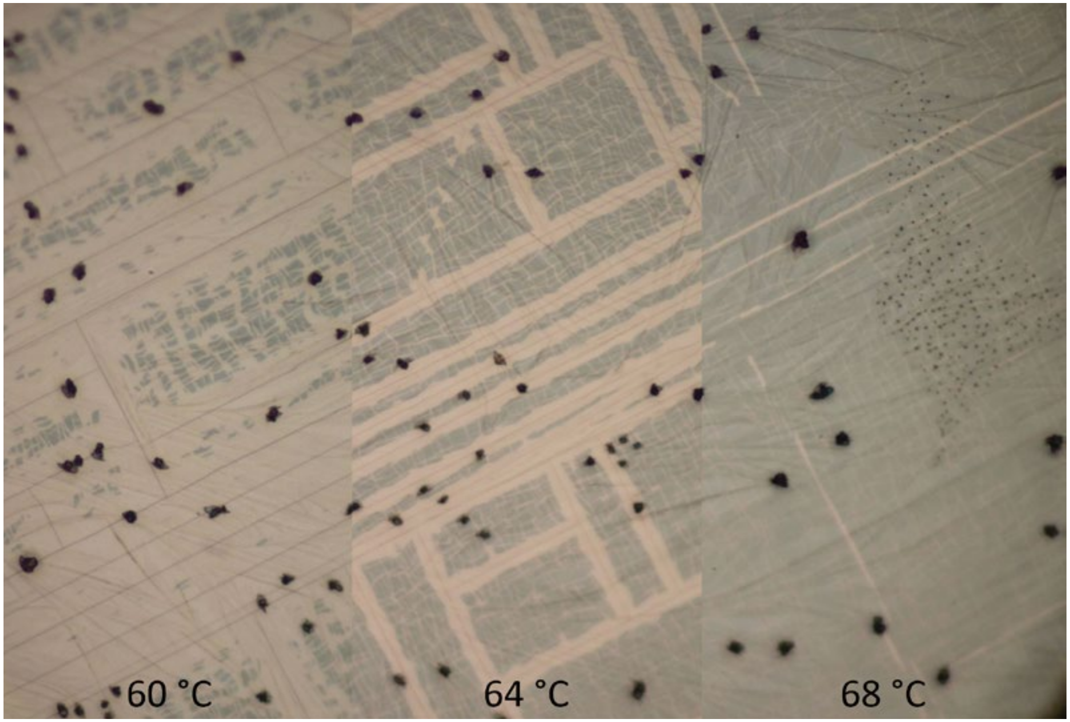
“Inspired by Nature, where spontaneous emergence of structure and functionality is ubiquitous, we aim to develop a different kind of engineering, *nonlinearity engineering*, based on exploitation of complex nonlinear dynamics through judicious use of intense laser beams.”

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

Dr. Serkan Kasırga

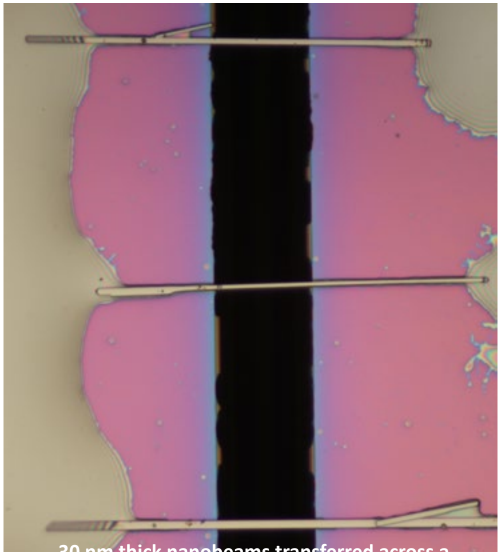
Strongly Correlated Materials Laboratory

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

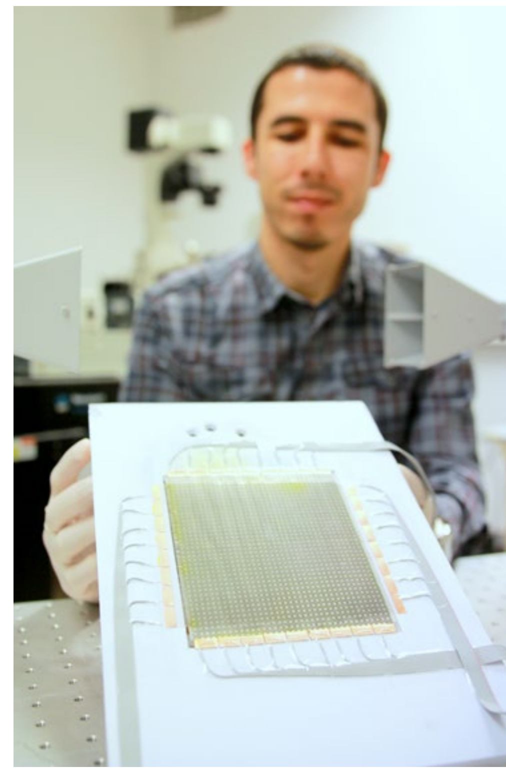
Our group is working on synthesis of new quantum materials and their integration in to electronic and photonic devices. Our long term goal is to understand and engineer electronic and optical responses of emerging quantum materials. Using these quantum materials we would like to develop multidisciplinary 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

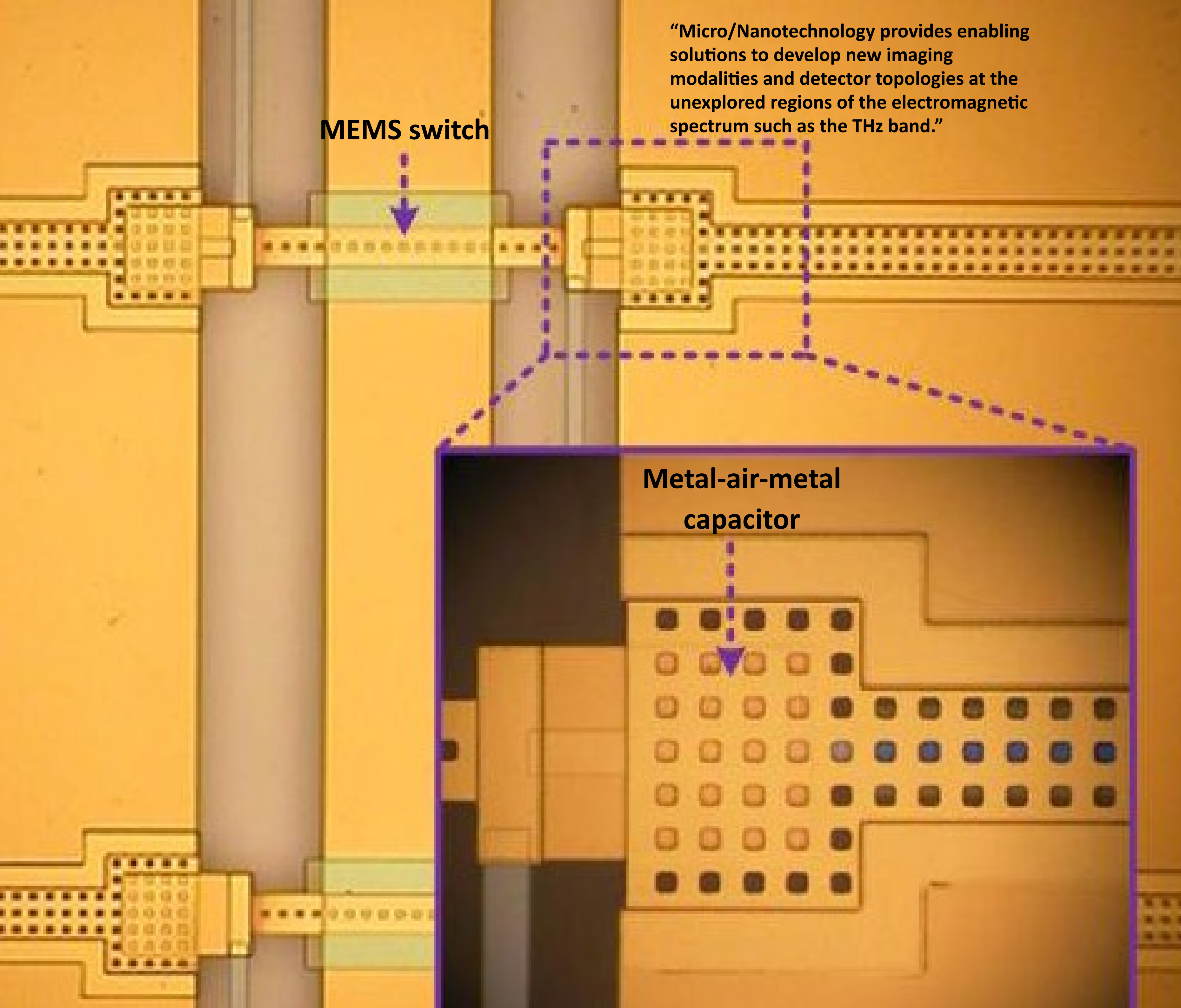
Radar-absorbing materials are used in stealth technologies for concealment of an object from radar detection. Resistive and/or magnetic composite materials are used to reduce the backscattered microwave signals. Inability to control electrical properties of these materials, however, hinders the realization 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."
MEMS switch
Metal-air-metal capacitor

Dr. Kağan Topallı

Reconfigurable Micro/Nano Systems for EM Waves

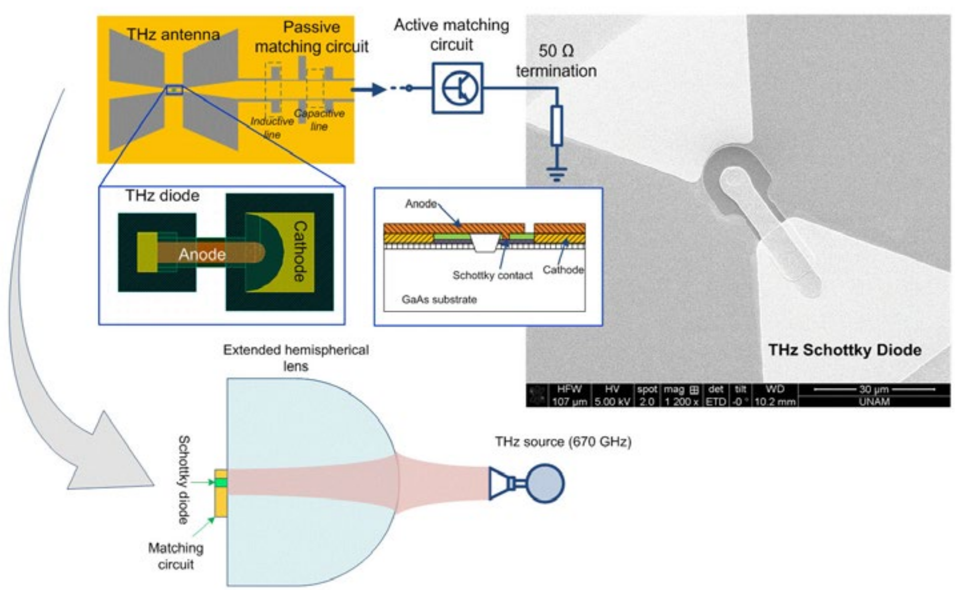
We are working on developing reconfigurable antennas and microwave devices using micro/nanotechnology as an enabling tool from microwaves to terahertz frequencies. The research involves interdisciplinary research activities related to electromagnetic waves and micro/nanofabrication. In particular, we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

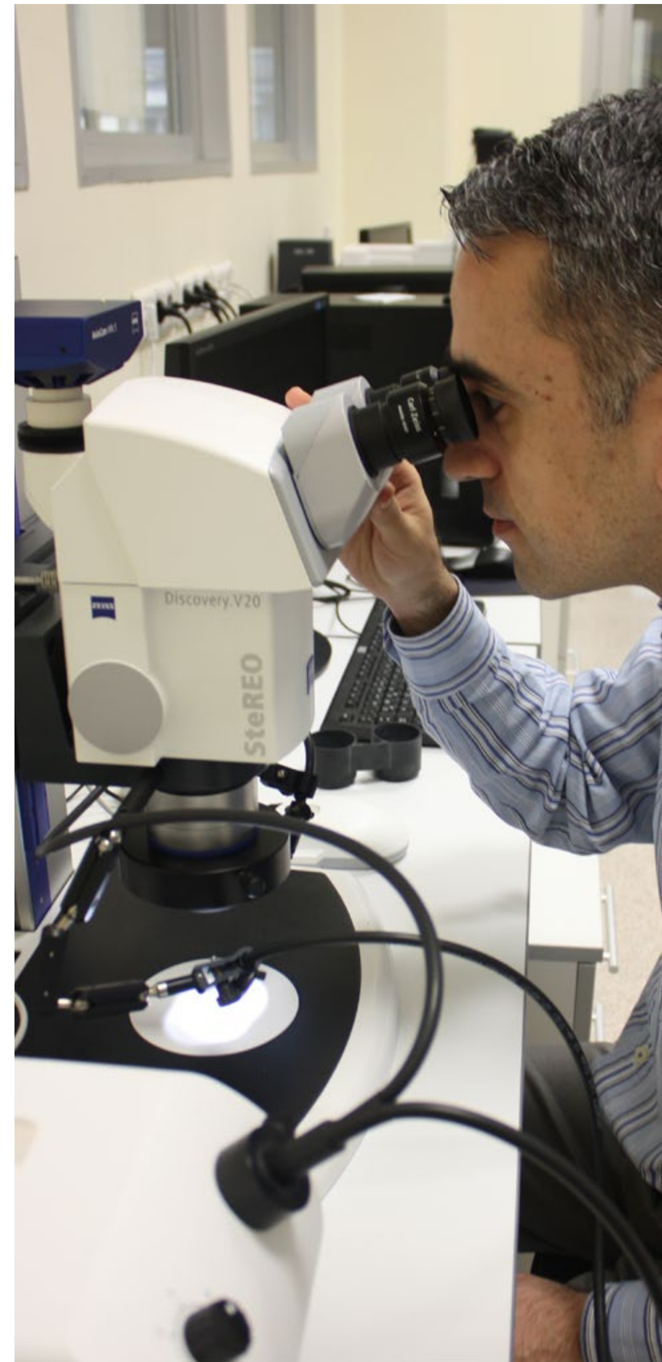
THz detection and imaging:

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:

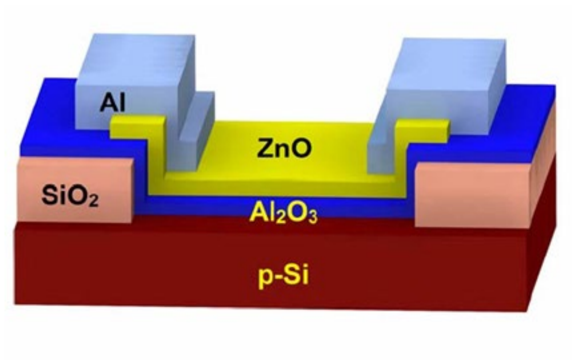
Over the past decade, RF microelectromechanical systems (MEMS) technology has offered solutions for the implementation of novel components and systems. This technology promises to solve many limitations of other technologies (pin diodes and FET switches), especially for high-frequency applications. RF 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.

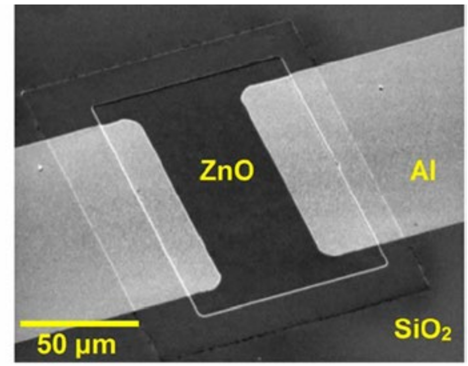




Integrated Devices and Sensors for Functional & Smart Systems

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.





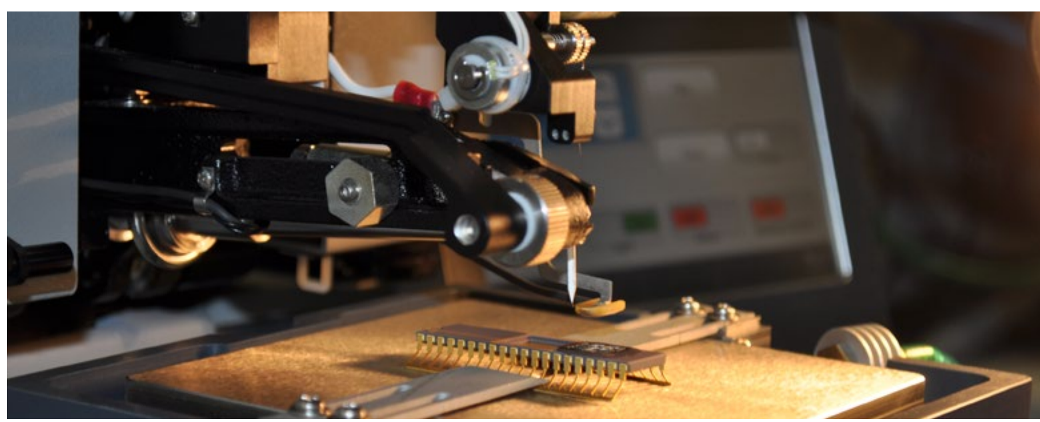
Cutting edge research

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."

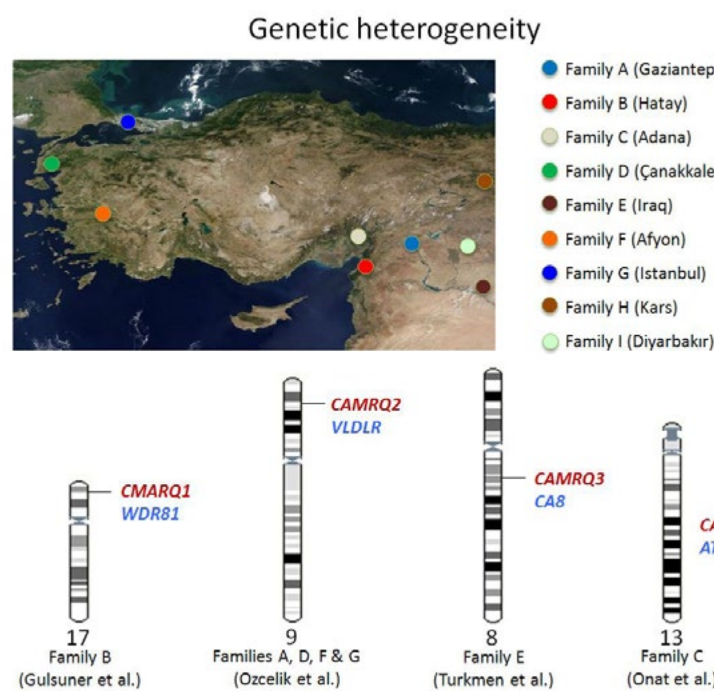
Dr. Tayfun Özçelik

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.



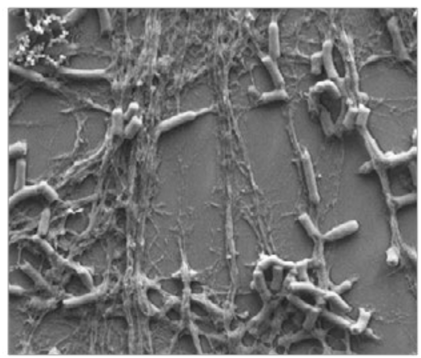
Dr. Urartu Şeker

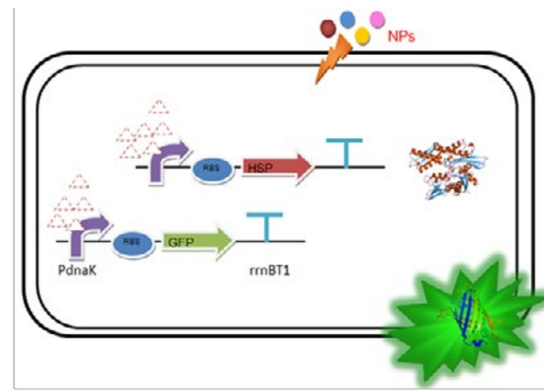
Synthetic Biosystems and Bioengineering

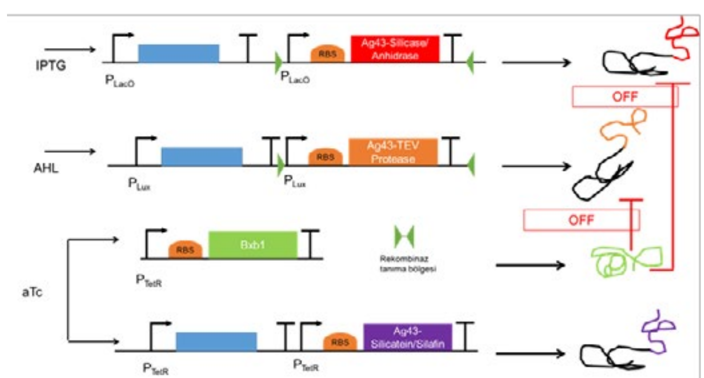
Synthetic Biology is an emerging engineering discipline which focuses on designing and implementation genetic devices inspired by electrical engineering and computer science. We are interested in designing and implementation of genetic circuits: to build whole cell sensors, to create novel biocatalysis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

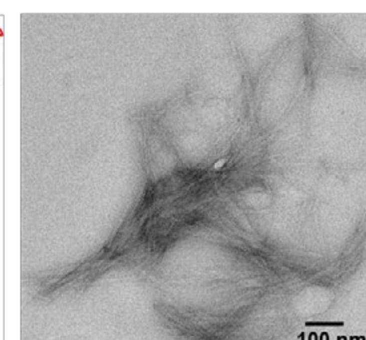
Synthetic biology is changing our view for designing of new organisms with synthetic gene expression and its synthetic regulations for a desired functionality. Synthetic biology is aiming to engineer both native metabolic pathways and exploring novel pathways in an organism for advanced well controlled 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 / biomedical applications.









"Synthetic Biology will revolutionize many areas by providing the richness of the life sciences as a tool for research and industry. Nanotechnology and materials science will benefit a lot from synthetic biology at the nano-biointerface."

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.

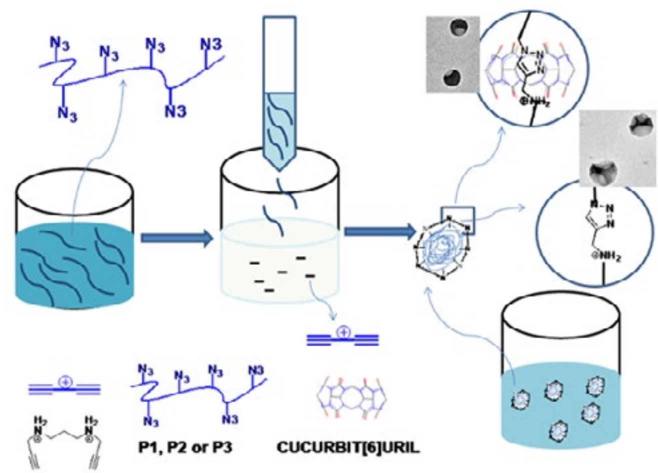
Dr. Dönüş Tuncel

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:

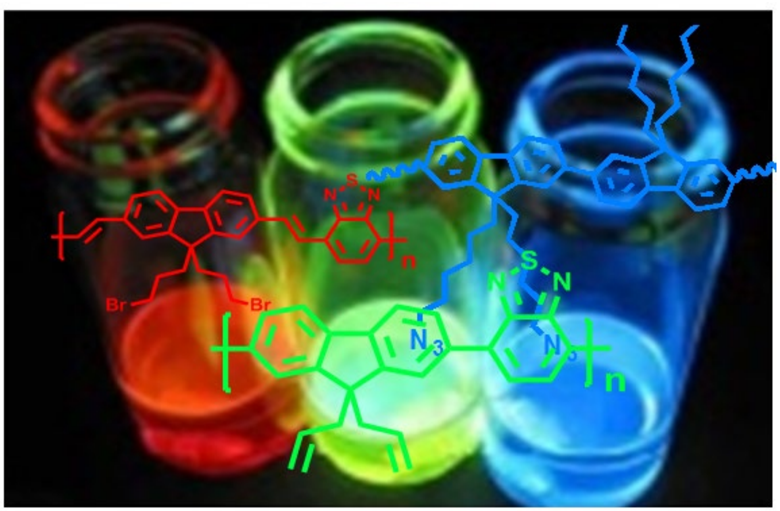
Cross-linked patchy fluorescent conjugated polymer nanoparticles synthesized by click reactions

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

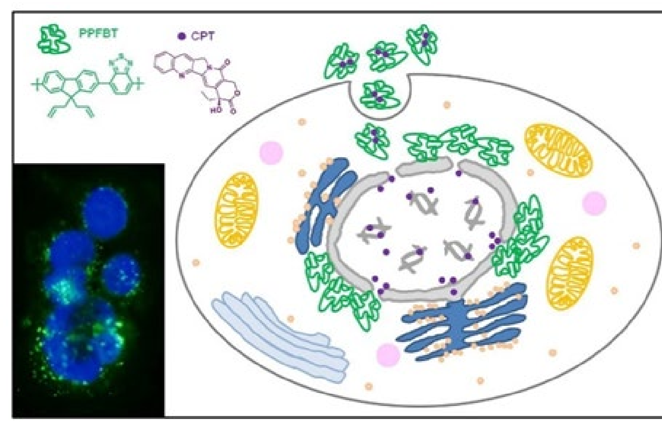


Light emitting conjugated polymers

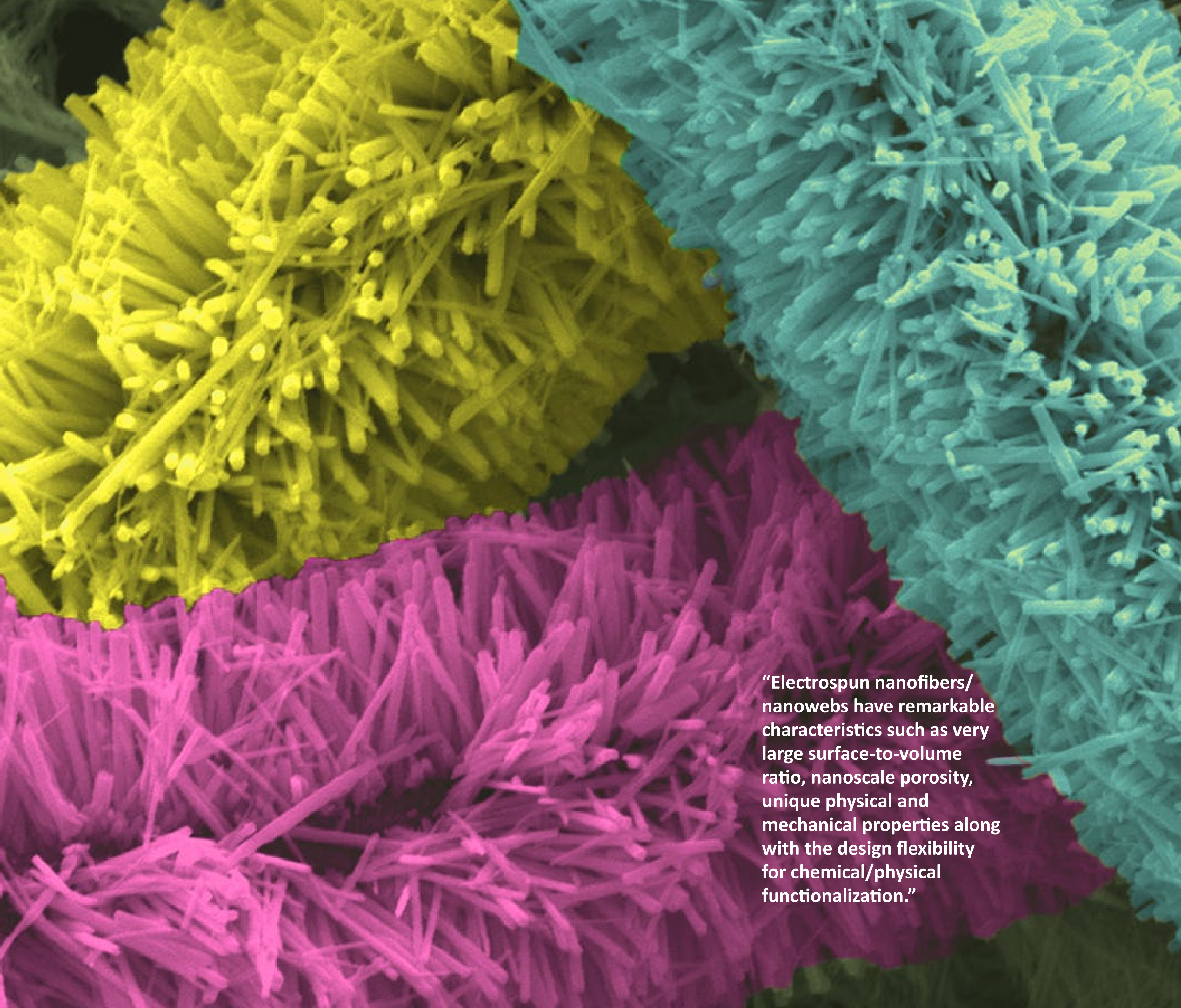
Blue, green and red emitting conjugated polymers which contain a variety of funtional groups are synthesized and their applications are exploited in the areas of optoelectronics and chemo and biosensing.



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.”



"Electrospun nanofibers/ nanowebs have remarkable characteristics such as very large surface-to-volume ratio, nanoscale porosity, unique physical and mechanical properties along with the design flexibility for chemical/physical functionalization."

Dr. Tamer Uyar

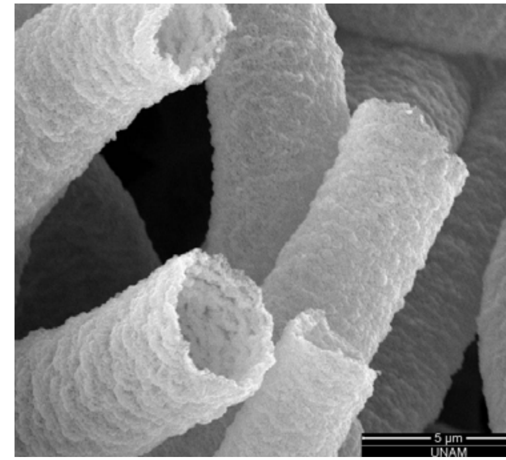
Functional Nanofibers via Electrospinning

Electrospinning is as a versatile and cost-effective technique for producing functional nanofibers from various polymers, blends, composites, sol-gels, ceramics, etc. Electrospun nanofibers/nanowebs have several remarkable characteristics such as very large surface-to-volume ratio, highly porous within the nanoscale, unique physical and mechanical properties along with the design flexibility for chemical/physical functionalization. The outstanding properties and multi-functionality of these nanofibers/nanowebs make them favorable candidates in many areas including healthcare, filtration, textiles, energy, sensors,electronics, environment, food, packaging, agriculture, etc.

Electrospun Nanofibers

We have a main focus on electrospinning of nanofibers/nanowebs with novel functionalities for potential applications in filtration (molecular filters, water purification, waste treatment), biotechnology (wound dressing, controlled/sustained release systems), food and active food packaging (delivery and stabilization of food additives; essential oils, antioxidants, antibacterials), energy (solar cells, LIBs), sensors (gas sensor, biosensor, heavy metal and explosive detection, VOCs), textiles (delivery and stabilization of textile additives, protective clothing) and high performance composites.

Cyclodextrins (CD) are cyclic oligosaccharides having a toroid-shaped molecular structure. Cyclodextrins form non-covalent host-guest inclusion complexes with various molecules. CD and CD inclusion complexes (CD-IC) are already being used in pharmaceuticals, functional foods, filtrations, sustained/controlled delivery systems and textiles; therefore, incorporating CD and/or CD-IC in nanofibers hopefully extend the use of CD in the fields of biotechnology, food, filtration, textiles, etc. Uyar Research Group have special interests in Electrospinning of polymer-free CD and CD-IC nanofiber, , in addition, variety of functional electrospun polymeric nanofibers incorporating CD and CD-IC are also produced. Our research interests also cover surface functionalization of electrospun nanofiber by atomic layer deposition (ALD), electrospinning of nanofibers incorporating nanoparticles/nanostructures as well as fundamental understanding on electrospinning process and structure-property relationship of electrospun nanofibers.



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

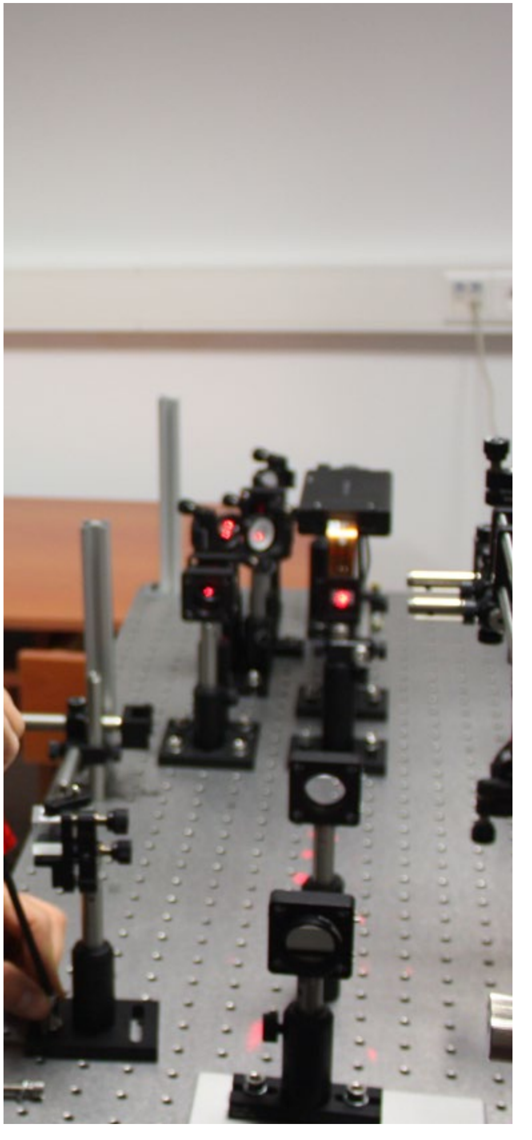
An optical tweezers is generated by a highly-focused laser beam and is capable of trapping and manipulating microscopic particles, such as cells, organelles and molecules. We are developing the optical tweezers technique so that it can explore new ranges of applications towards the nanoscale.

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.

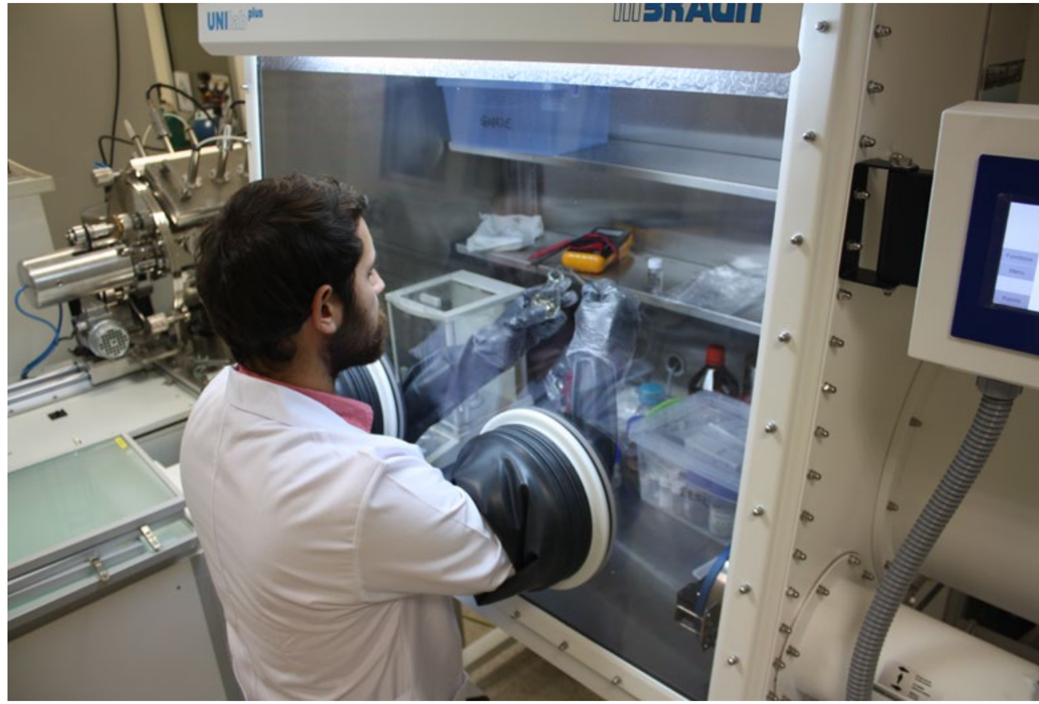


"The intersection of statistical physics, soft matter and optical manipulation creates us opportunities in a variety of applications."

Dr. Eda Yılmaz

Electrochemical Energy Storage Systems

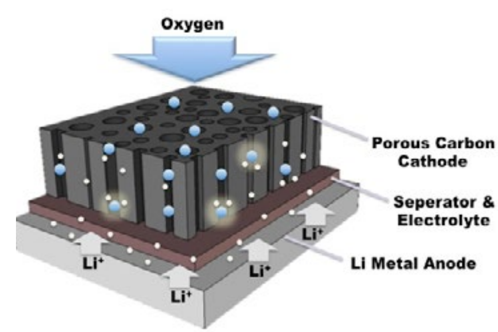
Energy storage has become one of the most challenging issues in recent years. Our research objective is to build "better" batteries, with higher capacity, stability and power density for various applications like portable electronics, electric vehicles and grid energy storage. We employ advanced characterization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

PUBLICATIONS & ACHIEVEMENTS

PUBLICATIONS

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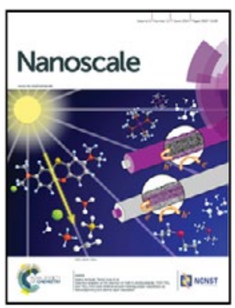
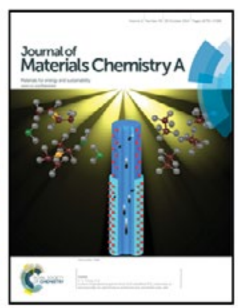
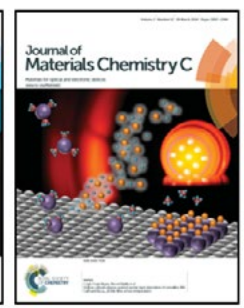
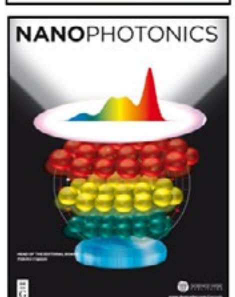
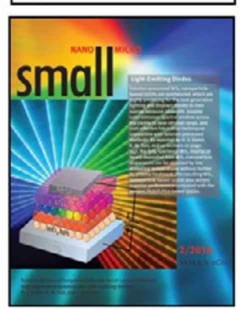
Some of these studies were selected as cover articles which demonstrates the revolutionizing potential of these studies.

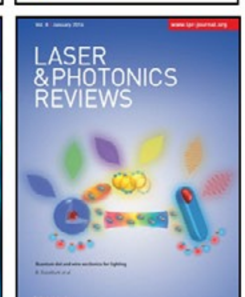


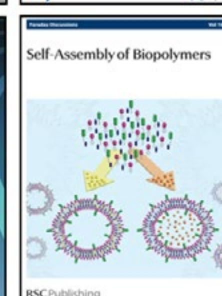












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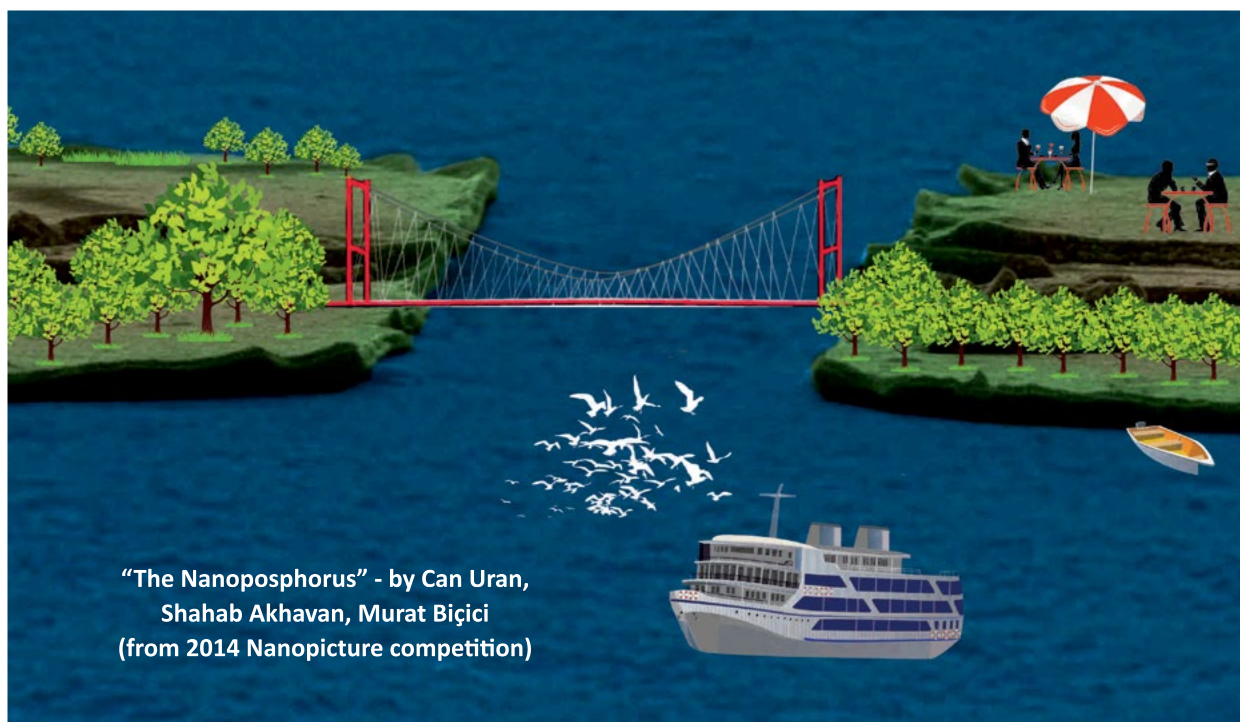
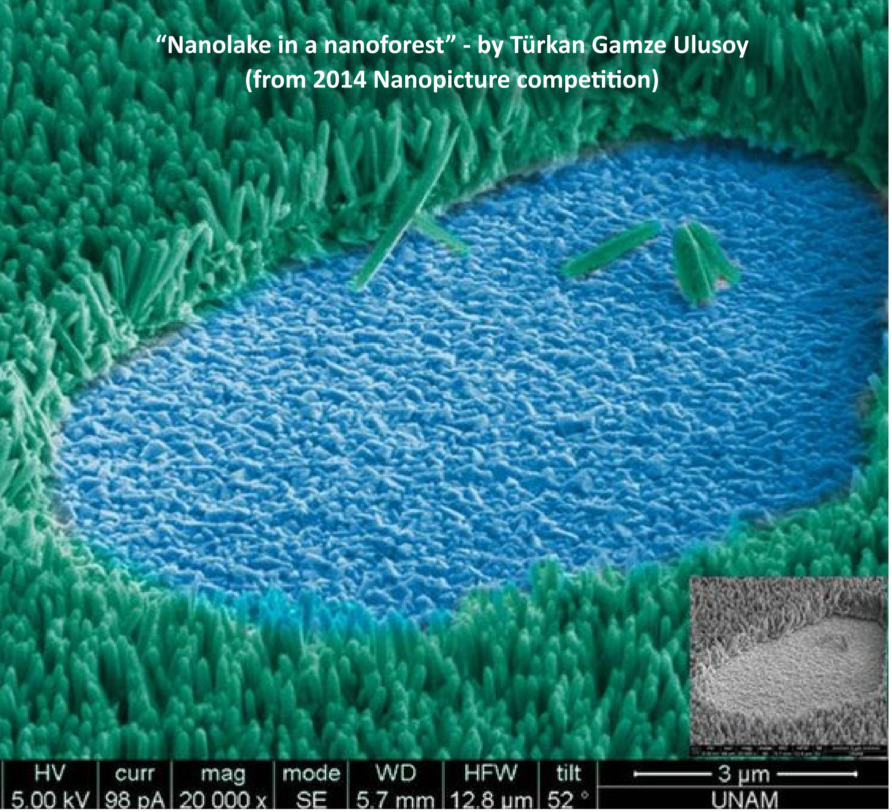
Out of the 62 submissions, the best two were awarded.



“The Nanoposphorus” - by Can Uran, Shahab Akhavan, Murat Biçici (from 2014 Nanopicture competition)



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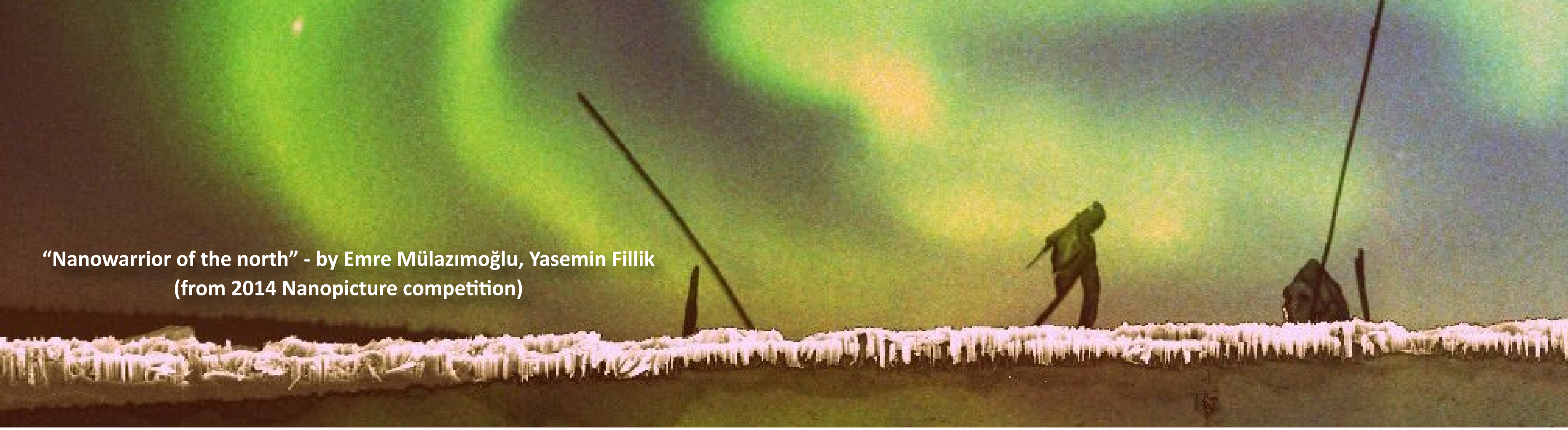

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“Nanoclimber” - by Mohammad Amin Nazirzadeh (from 2014 Nanopicture competition)

PRIZES & AWARDS

Dr. Bülend Ortaç and Dr. Tamer Uyar received 2014 TÜBİTAK Incentive Award

UNAM researchers Asst. Prof. Bülend Ortaç and Assoc. Prof. Tamer Uyar have received The Scientific and Technical Research Council of Turkey (TÜBİTAK) Incentive Award for 2014. The TÜBİTAK Incentive Award is given to scientists who are under the age of 40 and who have proven to have the potential to provide outstanding contributions to science in the future at an international level.

Dr. Mehmet Z. Baykara received 2014 FABED Eser Tümen Outstanding Young Scientist Award

UNAM researcher Asst. Prof. Mehmet Baykara has received this award for his accomplishments in the areas of scanning probe microscopy and tribology. The awards are presented to young scientists in recognition of their exceptional achievements and research productivity, in honor of influential engineers Feyzi Akkaya and Eser Tümen.

Mustafa O. Guler received 2014 JCI TOYP Scientific Leadership 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. Bülend Ortaç received Mustafa Parlar Award and Distinguished Young Scientist (BAGEP) Award

The Middle East Technical University Parlar Foundation recognizes the achievements of scientists and scholars from a variety of fields for their exceptional research productivity, in honor of the late METU professor, Mustafa Parlar. This year, Asst. Prof. Bülend Ortaç of the Institute of Materials Science and Nanotechnology (UNAM), is among the recipients of METU Prof. Dr. Mustafa Parlar Foundation Research Incentive Awards.

Asst. Prof. Bilge Baytekin received National UNESCO-L'Oreal Award

The UNESCO-L'Oreal Women in Science Program aims to improve the position of women in science by recognizing outstanding women researchers who have contributed to scientific progress. Dr. Baytekin received the award for her research on an environment-friendly mechanochemical process to reduce the presence of two prominent, persistent organic pollutants in the environment. Her current research interests include polymers for energy applications, mechanochemistry and electrostatics.

Five UNAM researchers received 2014 TÜBA GEBİP - Young Scientist Award

Asst. Prof. Mehmet Z. Baykara, Asst. Prof. Urartu Şeker, Asst. Prof. Bülend Ortaç, Asst. Prof. Ali Kemal Okyay, Asst. Prof. Giovanni Volpe received 2014 Turkish Academy of Sciences (TÜBA) young scientist award. TÜBA awards successful young scientist prize every year to distinguished young scientist that produced high quality research in natural and social sciences and engineering

UNAM Receives IDB Science and Technology Prize

In recognition of its contributions to nanoscience and nanotechnology, UNAM has been awarded the Islamic Development Bank's (IDB) Prize for Science and Technology. This award is presented annually by the IDB to an institution that has made "an outstanding contribution to a given scientific discipline."

The award aims to acknowledge and encourage the achievements of scientific institutions in the IDB member countries. In the 13-year history of this program, UNAM is the third institution from Turkey to have received the prize. In 2005, the Bilkent University Department of Electrical and Electronics Engineering was the recipient of the award.

The prize includes a cash award of $100,000, a trophy and a certificate, to be presented by the chairman of the IDB Board of Governors at a ceremony to be held on the occasion of the 40th IDB Board of Governors meeting on 10-11 June 2015.

UNAM NANODAY 2014

On 26 May 2014, UNAM has organised the very first Nanoday Event. We have hosted Prof. Paul Weiss, Prof. Jackie Ying and Prof. Harold Zandvliet as keynote speakers. The event has attracted significant attention all across Bilkent University. We had approximately 220 attendees for this organization. In addition to oral presentations, we also had poster presentations and nanopicture contest. On the right, the winning nanopicture is shown.

NANODAY'14

Winner of the 2014 Nano Picture Contest
MicroBallerina by Şahin Coşkun


A picture from the 2014 Nanoday Event during Prof. Paul Weiss's speech

TECHNOLOGY TRANSFER in cooperation with BILKENT TTO

UNAM cooperates with Bilkent University Technology Transfer Office (Bilkent TTO) aiming to support the academicians and the researchers of Bilkent University to access funds provided by the national & international institutions and to establish collaborations with industry in order to realize their Research and Development Projects whose results can be transformed into internationally competitive and value added technological products or services used by the public.

The objective of this cooperation between Bilkent TTO and UNAM is to increase funding for their research projects, to establish more effective collaborations with the industry and encourage collaboration between researchers and different stakeholders. During 2014, Horizon 2020 ICT & FET Focus Group Meeting organized for UNAM researchers on 9th September 2014, important topics below were discussed in detail:

- Expected Impact from the selected call topics
- Continuation Projects
- Usual Suspects and Networks
- How to address the potentially successful consortiums and get acceptance
- Incentives and Prizes from TÜBİTAK

Besides these info days and focus group meeting organizations, Bilkent TTO and UNAM research groups are in close contact for the proposal writing and project management issues. It is expected that the number of joint activities involving the UNAM Researchers and Bilkent TTO will increase in the next years.

UNAM ICT-FET Focus Group Meeting, September 9th, 2014

OUTREACH

WORKSHOPS

4th International Workshop on Cleanroom Training for Critical and Sustainable Technologies - Sensors, 16 June - 27 July 2014

The workshop was a collaborative initiative of UNIDO and UNAM, and is supported by the Turkish Ministry of Science, Industry and Technology, Turkish International Cooperation & Coordination Agency (TİKA), and Turkish Ministry of Development.

Upon the success of the first organization in 2010, UNAM continued these events and this year the “4th International Workshop on Cleanroom Training for Critical and Sustainable Technologies” was organized. The programme was sponsored by Turkish Ministry of Science, Industry and Technology, Turkish International Cooperation & Coordination Agency (TİKA), and Turkish Ministry of Development. 32 international and 7 national, in total 39 participants from 14 different countries received their well-deserved certificates after completing the theoretical lecture/seminars and practical hands-on laboratory sessions.

Having concentrated on “Lab-on-a-Chip” and “Renewable Energy” aspects of nanotechnology and cleanroom-based micro/nano-scale functional device fabrication in 2012 and 2013, respectively, this year the focus theme was chosen as “Sensors”. In addition to a mind-opening keynote talk about “Compatibility Issues for Integrated Sensors” by Prof. Paddy French from Delft University of Technology, UNAM faculty provided lectures on cleanroom micro/nanofabrication processes. Theoretical part of the training ended with six research seminars, concentrating on different aspects of various sensor technologies. Weekend was devoted to a daily Konya excursion and mini world-cup football tournament, followed by the country presentations by each international participant. Afterwards, three-day long hands-on cleanroom sessions, during which a proof-of-concept sensor micro-device is fabricated, was carried out in parallel to cleanroom vendor workshops provided by Heidelberg Instruments, Centrotherm Clean Solutions and FEI inc. Participants had the opportunity to observe micro-fabrication steps of a simple sensor within the UNAM Cleanroom Facility, while they had the chance to learn about lithography, microscopy, and process gas delivery & waste gas abatement tools and technologies. Workshop program ended with a farewell dinner and closing ceremony including certification and UNIDO program evaluation.

Participants of the 4th International Workshop on Cleanroom Training for Critical and Sustainable Technologies

MSN seminar series

UNAM organized 35 seminars in 2014. Several distinguished speakers were hosted at UNAM. These seminars created a platform for exchange of ideas.

UNAM hosted the COST Action MP 1206 researchers

“International training school on Characterization of electrospun nanofibers”

Between 11-13th June 2014, Dr. Tamer Uyar organized a training school which was financially supported by COST Action MP1206-Electrospun nano-fibres for bio inspired composite materials and innovative industrial applications and UNAM-National Nanotechnology Research Center & Institute of Material Science and Nanotechnology, Bilkent University. Nearly 50 participants from 18 countries consists of experts, postdoctoral fellows and PhD students were participated in this training school.

High school students visit UNAM for BEWISE (Believe in Europe Welfare through Innovation Science Education) project

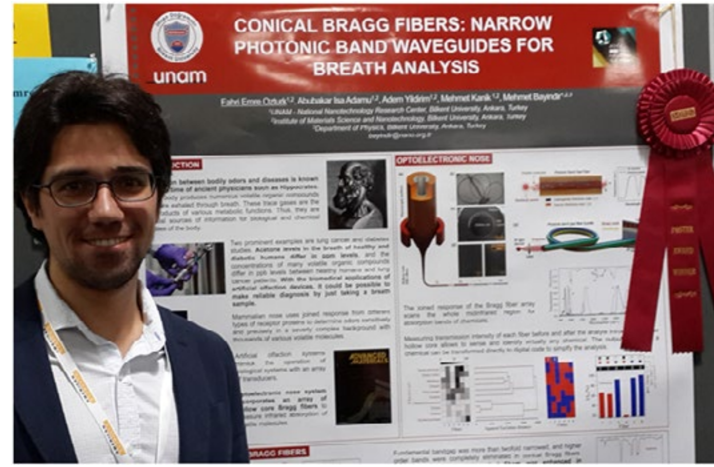
This project is run by three high schools in three different European countries and aims to break the linguistic and cultural barriers towards a stronger international scientific collaboration. The students from the three partner high schools have visited UNAM. The students have witnessed scientific experiments and listened crash courses from UNAM researchers. This trip unlocked the mysteries of the nanoscopic world to the young brains. The partner high schools are London St Joseph College (U.K.), Rouen Blaise Pascal Lycee (France) and Ankara Mehmet Ali Hasan Coşkun Anadolu Lisesi (Turkey).

UNAM hosted the Bioinspired Materials Conference

From October 20th to 21st, UNAM hosted the Bioinspired Materials Conference, dedicated to biological architectures and their manipulation for the design of advanced materials. Organized by Assoc. Prof. Mustafa Özgür Güler and Asst. Prof. Ayşe Begüm Tekinay of UNAM, the event was intended not only to illustrate the cutting-edge research being conducted by bioengineering and nanomaterials researchers all around the globe, but also to foster collaboration among scientists with different academic specialties, who have much to benefit from combining their expertise to better understand what a single discipline is unable to explain. Over 20 prominent scientists described their research at the meeting, which included eight sessions of oral presentations, as well as posters from both Bilkent researchers and conference attendees.

UNAM Ph.D. candidate won Materials Research Society (MRS) best poster award

Fahri Emre Öztürk, Ph.D. candidate at UNAM, won the best poster award at the Fall 2014 Materials Research Society (MRS) Meeting in Boston, USA. The annual Fall Meeting in Boston is the preeminent annual event of materials research, featuring over 50 symposia and attended by more than 6,800 researchers from every corner of the globe. MRS poster awards are given in recognition of the technical content, appearance and presentation quality.



Poster authors Fahri Emre Ozturk, Abubakar Isa Adamu, Adem Yildirim, Mehmet Kanik and Mehmet Bayindir were honored for their poster titled “Conical Bragg fibers: narrow band waveguides for breath analysis”. Their work comprised biomedical applications of the optoelectronic nose system developed at UNAM laboratories. The group was able to fabricate infrared photonic bandgap fibers which have very narrow transmission bands and demonstrated that the narrow band fibers can be potentially used for diagnosing diabetes from patients’ breath samples.

UNAM Ph.D. candidate receives Green Talent Award in Berlin

On November 7, Burak Güzeltürk, from the Devices and Sensors Research Group, received the internationally recognized Green Talent Award at a ceremony in Berlin. Burak was selected as one of the twenty-five winners of this year’s award by a jury of experts under the patronage of Germany’s Federal Ministry of Education and Research; Minister of Education and Research Johanna Wanka presented the awards at the ceremony. The Green Talent award is given to tomorrow’s leading young scientists and visionaries in the field of sustainable development. This year marks the sixth time the competitive award has been presented; there were more than 800 applications from over 100 countries around the world.

Burak was selected as an award recipient on the basis of his ongoing PhD thesis research work under the supervision of Prof. Hilmi Volkan Demir. His research focuses on semiconductor nanocrystal devices for highly efficient optoelectronic technologies, including light-emitting diodes and lasers. He has recently demonstrated record high efficiency in colloidal lasers.

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

In 2014, UNAM received Cyberpark “The company with the most funded project” Award.

▪ UNAM is a Cyberpark research center ▪

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