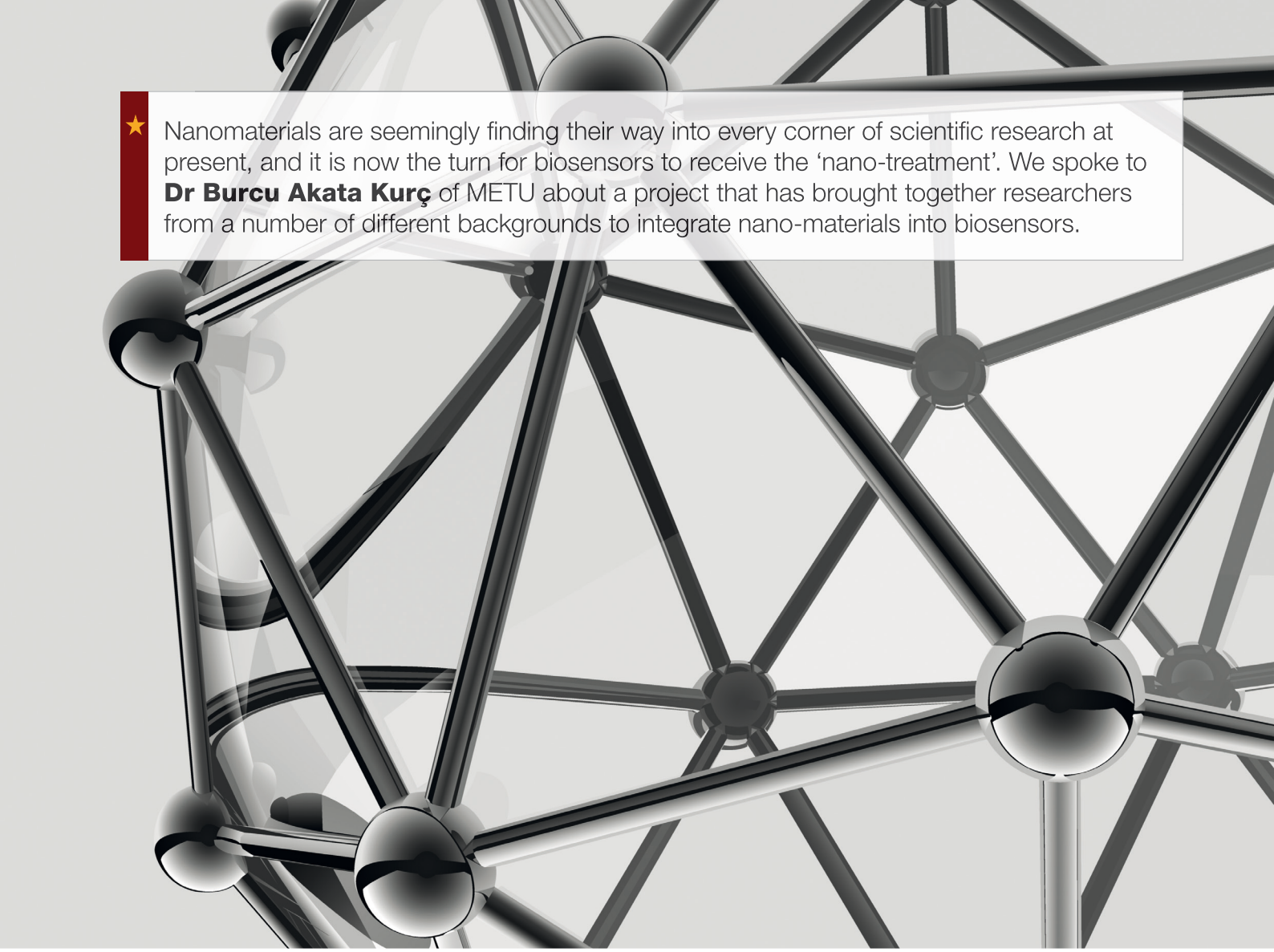


Nanomaterials are seemingly finding their way into every corner of scientific research at present, and it is now the turn for biosensors to receive the 'nano-treatment'. We spoke to **Dr Burcu Akata Kurç** of METU about a project that has brought together researchers from a number of different backgrounds to integrate nano-materials into biosensors.

Biosensors receive the Nano Treatment

NanoBioSens is a project that has brought together an international and interdisciplinary assembly of research teams in order to share the knowledge of the different elements involved in building nano-biosensors. The development of future devices will require the controlled assembly and placement of nano-building blocks into desired locations. Through accomplishing this task, the advantages of the integration of nano-materials into the structure of biosensors will become attainable.

"My expertise is in the field of nanomaterials, specifically zeolites and zeo-type materials, and their use in advanced applications, such as nano-sensors and photovoltaics," begins Kurc. "The aim of the project was to build nano-devices for actual applications through the controlled integration of nano-materials into specific parts of these devices, and so with my expertise alone this would not have been possible. That is why I decided to form an interdisciplinary group of partners, so that collaboratively we could achieve what none of us could have done by ourselves."

The team Kurc has fashioned includes researchers from six different countries with expertise areas in the field of chemical engineering, biomedical engineering, materials science, physics, chemistry, and biology. She gives some examples of how this diversity within the team, along with the additional value of her membership of the METU Central Laboratory, has been of the utmost importance to the success of the project.

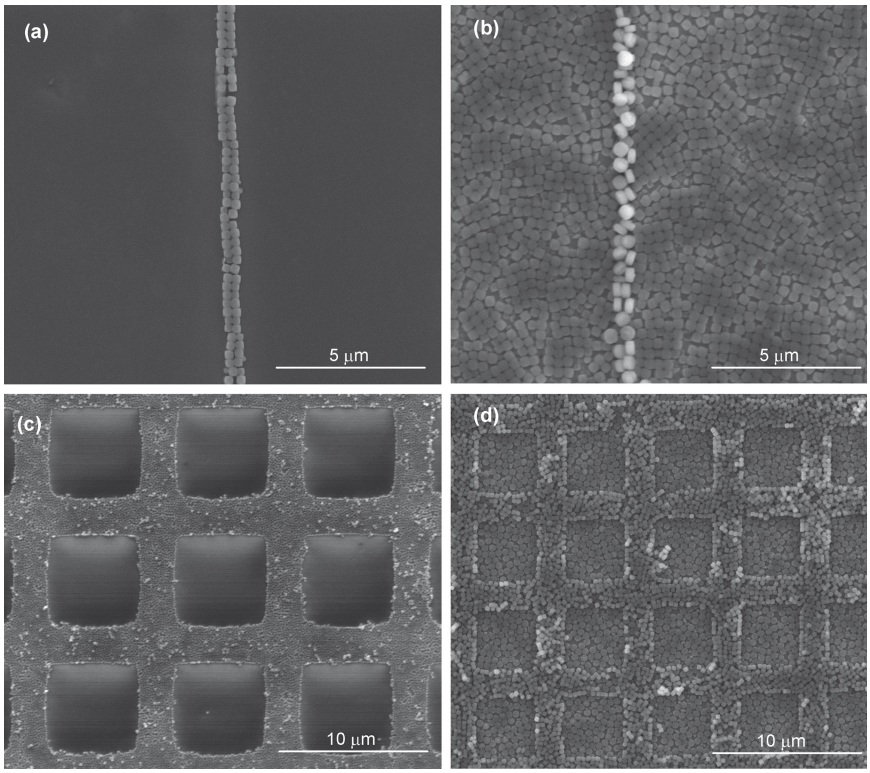
"Our partner from the USA, Prof. Al Sacco Jr., who is a former astronaut and currently the Dean of Engineering at Texas Tech University, is an expert in the field of zeolite synthesis," she explains. "Our research teams worked together making what nano-sensors needed for controlled optimization of transducers. Our partner from Korea, Prof. Kyung Byung Yoon of Sogang University, who is currently the Dean of the College of Natural Science, brought to the project his expertise on how to attach nano-materials onto surfaces. When nano-materials are synthesized, they are generally produced in a powder-form which you cannot fix on to anything, and so in order to test their potential applications they have to be attached using specific substrates dependent on the material they are being attached to.

"On the other hand, we have our biosensor experts, Prof. Nicole Jaffrezic-Renault and Prof. Sergei Dzyadevych from France and the Ukraine, who have their own techniques for immobilising biological molecules in order to get different responses from different biological compounds. However, they lack the experience of working with nano-materials, and so through bringing these researchers together we have been able to get some great results."

In terms of scientific accomplishments, the team has managed to create organized nano-patterns of zeolites on silicon wafers for the first time. This means that they are able to attach zeolite nanocrystals and attach them in very specific positions, which is an essential skill needed to begin using nano-materials in nano-devices.

"Whatever surface you are using (be it silicon wafers or gold coated silicon wafers), once you can accurately attach nano-materials to it you can then begin to test the potential of that nano-material in an actual device," says Kurc. "In current literature, the only studies available in this field tend to be on subjects such as protein adsorption properties, with very little data from devices to see whether the materials are fulfilling their role in the finalised devices."

Once the team had mastered this, they began integrating these materials and surfaces into devices provided by the French and Ukrainian partners so as to test their potential uses. Current work by students under Kurc involves attaching neuron cells into these devices at McGill University working with the team of Prof. Mariam Tabrizian, who is an expert in the field of nanostructured platforms for tissue engineering and biosensor applications, the results of which will be published in the near future.



Precise control of zeolite nanocrystals on Si wafer; double zeolite lines (a), Silicalite double lines formed on zeolite A monolayer (b), square patterns of zeolite A monolayer (c), and square patterns of zeolite A monolayer on Silicalite monolayer (d).

With the project coming to an end in January 2012, Kurc is very positive about the impact she hopes the research will have. "We have opened the gate for being able to control and modify what data is taken from these biosensors, because we can now control factors such as the pore size, surface groups, particle size and thus the surface area of these nano-materials very precisely.

"This allows you to modify the surface of your device according to your goal," she continues. "For example, if you want to observe a certain biological molecule and you know what that molecule is sensitive to, you can make your surface sensitive to those particular parameters."

Future work has already been planned, with additional partners from China also joining in for the next stage of research. With the current project having proven that it is possible to modulate and control what signal a device is measuring, the next steps will involve improving the devices not only in the field of biosensors, but also for photovoltaic applications, by using more sophisticated nano-materials. Over time, it is hoped that this line of research will help biosensor structures to show enhanced sensitivity. ★

Middle East Technical University – Ankara

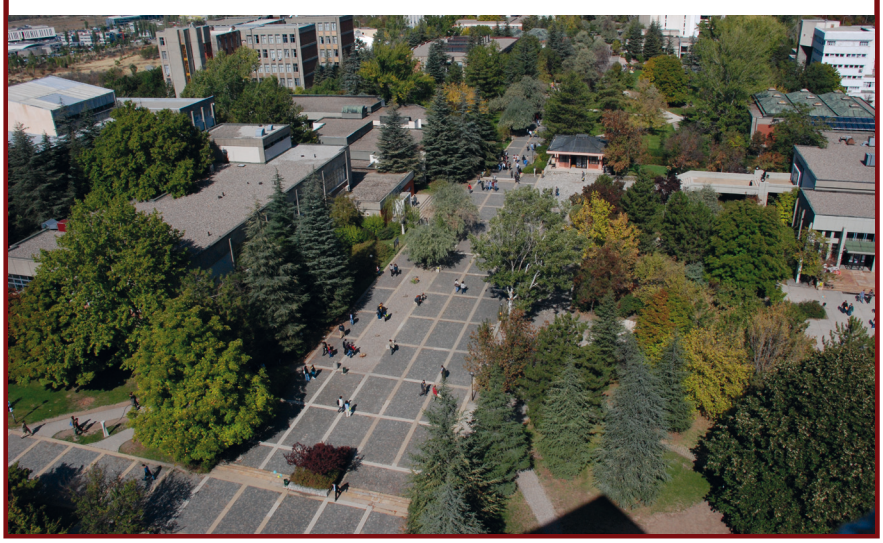
Middle East Technical University (METU), founded in 1956, is an international research university based in Ankara, Turkey. Since its inception, it has strived to improve its research activities by increasing collaboration between national and international research organizations, setting up close links with the industry, encouraging multidisciplinary work and continuously restructuring its organization to create a research environment that fosters innovation. The University's research priority areas are defense and space, information technology, renewable energy and sustainability, advanced materials and biomaterials.

METU is the leading international research university in Turkey in terms of depth and breadth of international research projects and the amount of funds generated from research activities. Research activities carried out by faculties, graduate schools and research centres - with around 350 on-going projects sponsored by various international and national agencies, as well as the industry - generate around 40 million Euros per year, corresponding to more than 30% of the total revenues of METU each year.

Middle East Technical University is the premier university in Turkey in terms of the number of EU Framework Programme projects. In FP 7, METU has taken part in 113 projects with a total budget of 380 million Euros and a METU share of 18 million Euros. A wide spectrum of international COST, EUREKA, MEDA, NATO, NSF, UN, World Bank and Jean Monnet projects have also been carried out by METU researchers.

As part of its research and development vision, METU gives priority to graduate education and consequently, graduates around 200 Ph.D. candidates every year.

Last but not least, METU has the first and biggest science and technology park, namely METU Technopolis, in Turkey, with over 250 High-Tech companies and more than 3300 R&D personnel employed.



At a glance

Project Information

Project Title:
NANOSENSORS BASED ON NANOMATERIALS

Project Objective:
The primary objective is to bring together an international and interdisciplinary group of research teams with different expertise areas to assemble different elements for building nano-devices.
Future devices will require controlled placement of nano blocks into desired locations. The project opens the gateway for integrating nanomaterials into the nano-devices.

Project Duration and Timing:
3 years: January 2009-January 2012

Project Funding:
FP7-PEOPLE-IRSES / 333,000 €

Project Partners:
Middle East Technical University
Université Claude Bernard Lyon 1
Institute of Molecular Biology and Genetics of National Academy of Sciences
Northeastern University
McGill University
Sogang University

Burcu Akata Kurç

She received her PhD in chemical engineering in 2004 from Northeastern University (NEU)-USA. She prepared synthesis solutions for five different space shuttle missions during her NASA work at NEU. She is an Assoc. Prof. at the Micro and Nanotechnology Department/Central Laboratory-METU. Her interests are nanoporous and functional materials, and microfabrication of nanomaterials.

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