Groundwork laid for Mexican-French biosensors

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Prof. Dr. Vivechana Agarwal is a Materials Scientist at the Research Centre in Engineering and Applied Sciences, Autonomous University of the State of Morelos (CIICAP, UAEM), in Cuernavaca, Mexico. She visited the MINATEC research centre of the Centre for Atomic Energy in Grenoble, France, earlier this year.

What have you worked on during your visit?

A material with tiny pores, structured in the nanometre size range, can be formed by etching crystalline silicon by electrochemical means. I have studied the effect of the frequency of the electrochemical Gaussian current on the morphology (pore size and thickness) of porous nanostructures formed in this way.

Why is that important for your research and for progress in nanotechnology?

Due to the versatile nature of porous silicon, it has been established as a promising material for photonic applications like dielectric mirrors, waveguides and sensors. This porous nanostructure has a tremendous surface area (almost 500-1000m^2/cm^3) and is biodegradable so it is being used as a biosensor as well. Hence this project helps exploring the possibility to make the nanomaterial more regular. The electrochemical etching process is used for growing multilayered photonic structures (consisting of many thin layers on top of each other). The quality of the interfaces of these photonic structures can affect the photonic properties and hence the sensitivity of the particular type of biosensor which makes use of interference of light.

Why did you come to this European research centre to do this project?

First: They have all the possible facilities to characterize a nanostructure.
Second: To know more about the different fields European research centres are working on.

What are the results? How will you disseminate them?

Some of the results of the project can be summarized as follows: The morphology of the nanostructured porous silicon was partially influenced by the signal frequency. The size of the nanocrystals and the pore structure almost remains the same for all the frequencies and amplitudes. The interface gets less rough if the amplitude (strength) of the signal increases for higher frequencies of light. At a particular frequency, the smoothness of the interface was found to be independent of the amplitude of the signal. This characteristic frequency can help us in making better photonic devices.

Is this the first contact between both organizations or is your visit part of existing collaboration? What are the plans for future collaboration?

This is my first visit to Minatec, Grenoble. I had no previous collaboration with this institute. I and Pierre Noe are planning to collaborate with each other on the doping of the photonic structures with the rare earth elements. Next year one of my PhD students is going to work with him for 3-6 months. We intend to apply for funding in the EU 7th Framework Programme for RTD.

How may your project in the long term benefit the development of your country or Latin America in general?

Now-a-days nanotechnology is an upcoming interdisciplinary field of research all over the world. Such projects in general help in the better understanding of the fundamental aspects related to nanostructures and their possible applications. In general, biotechnology is a strong research field in Mexico, so a work on porous silicon nanostructures will help in bringing together the people from biotechnology (for developing the biosensors), chemists, physicists and material scientists.

What are your plans for disseminating the results of your visit outside the research community in your country?

Well! I think I would start with writing a small article in Spanish about the project work done in Minatec for the local journal.
We didn't have enough time to take our results to the application part. So only the fundamental part would be demonstrated.

Identification:
Prof. Dr. Vivechana Agarwal, Materials Science, vagarwal@uaem.mx
Home organization: Research Centre in Engineering and Applied Sciences, Autonomous University of the State of Morelos (CIICAP, UAEM), Dept. Materials Science, Cuernavaca, Mexico, www.ciicap.uaem.mx
Host organization: CEA, MINATEC, Grenoble, France, www.minatec.com.