



Toulouse, January 04 2010

**POST-DOCTORAL POSITION  
FOR THE FABRICATION AND PHYSICO-CHEMICAL STUDY  
OF NANODEVICES  
USING ION IMPLANTATION AND TEM-EELS**

- within the nMat group at CEMES-CNRS, Toulouse, France
- for a period of 12 months (possibility of renewal for a second year)
- starting February-March, 2010
- position financed by the ERANET project "NANOBLOCK"  
(NANOdevice fabrication using BLOCK-copolymer based technology)
- salary: 2100 € per month

The objective of the NANOBLOCK project is the growth and manipulation of semiconducting (silicon and metallic gold) nano-objects (nanodots, nanowires) in/on an oxide matrix in order to fabricate devices in which the different fabric elements will be interfaced to create a new generation of nano-transistors, nano-memories and nano-emitters. The placement of these nano-objects will be controlled by templated-self-assembly, i.e. the combination of conventional lithography and self-assembled block copolymers (BC). By combining "bottom up" self-assembled BC thin films with "top-down" patterned templates it is possible to precisely control the positioning of nanodot and nanowire arrays and even of single nanodot or nanowire in a well-defined location. This will provide a unique opportunity to study the interfacing of these nano-objects and to achieve their electrical and optical coupling both at nanoscale level (individual behavior) and on large assembly of nano-components (macroscopic behavior).

Three steps will be considered along the project. The first part of the project will be devoted to (i) the implementation of e-beam lithography protocols for the definition of suitable test patterns and to (ii) the development of block copolymer self-assembling processes in order to obtain nano-structured templates registered to the underlying topographically defined pattern. Then, fabrication of nanodots and nanowires will follow the formation of the nano-structured template using three different approaches, among them ion beam synthesis. Finally, design, fabrication and test of various nano-devices will be conducted.

The equipments and skills in ion implantation and transmission electron microscopy of the nanoMaterial for electronics group at CEMES will be exploited within this project. The ion implanter facility is a customized Varian DF2A200 system, which has been modified to extend the ion energy down to 0.6 keV. The implantation can then be performed from 0.6 up to 200 keV. Nearly all species can be implanted on wafers of 3" diameter in the above conditions. This group is actively developing "quantitative" TEM so that size-distributions, densities and volume fraction of the precipitate material can routinely be measured with high accuracy using transmission electron microscopy coupled to

electron energy-loss spectroscopy. The “TECNAI” FEI microscope is the highest-level microscope recently installed in the CEMES. It is a TEM-FEG fitted with a Cs corrector allowing to obtain images free of delocalization effects with a point resolution of 0.12 nm. Moreover, the microscope is also fitted with an energy-filter “TRIDIEM”, which is the last version of the GATAN spectrometer unique in Europe. Specimen preparation for the TEM from real devices can be performed by Focused Ion Beam (FIB) CrossBeam system, a ZEISS XB1455 machine, which can deliver a minimum focused ion spot of 10 nm in diameter. Ion species available are gallium, gold and silicon.

Within this framework, the candidate will be required to participate to the fabrication step using ion implantation (the machine is already managed by a permanent engineer) and most essentially to the physico-chemical investigation of the nano-devices using TEM-EELS techniques. This project would suit a candidate with strong experimental and communication skills (reports, papers and oral presentation of the results). Proficiency in the use of TEM-EELS is required together with a background in semiconductor physics and materials science.

The post-doctoral position is located at CEMES which is a laboratory of the “National Center for Scientific Research” (CNRS) set in Toulouse and will be developed within the nMat group (<http://www.cemes.fr/nMat>).

The applications should include curriculum vitae and give complete information about the applicant's education, experience and publications (copies of the best papers) together with recommendation letters. Applications are being considered now till around mid-february 2010.

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