

Pico-Inside Integrated Project ***Computing inside a single molecule using atomic scale technologies***

Christian Joachim

*CEMES-CNRS, 29, rue Jeanne Marvig,
31055 Toulouse Cedex 4 , France , France*

[*joachim@cemes.fr*](mailto:joachim@cemes.fr)

Creating an Atomic Scale Technology is now a necessity for any uni-molecular device and machine in molecular electronics, molecular mechanics, molecular transducers and for laboratory scale experiments on one molecule. In the IST priority 2 of FP6 (Emerging Nanoelectronics FET proactive initiative), the Pico-Inside consortium will explore Atomic Scale Technology with the final goal of integrating a complex logic gate inside a single molecule.

For reference, Atomic Scale Technology recently arose from the very precision (better than 0.05 nm) required to interconnect a molecule and from the demonstration of a conformation change inside a single molecule with a precision better than 0.1 nm. Atomic scale technology is a bottom-bottom approach using the bottom-up one of nanotechnology to solve the nano to mesoscale nano-communication problem.

In Pico-Inside (<http://www.picoinside.org>), 15 academic and industrial research institutes in Europe will work together on (1) new intramolecular architectures for integrating a complex digital logic function inside a single molecule, (2) understanding the electronic and mechanical behaviour of a single molecule on a surface with the best LT-UHV-STM and UHV-NC-AFM instruments in Europe , (3) the 5 stages of the interconnection problem from the atomic to the macroscopic scale: 50 pm to 1 nm (atomic wires), 1nm to 5 nm (mesa island), 5 nm to 50 nm (dynamic nanostencil), 50 nm to 5 um (static nanostencil), 5 um to 1 mm (micro-cantilever array), (4) organic chemistry for synthesising the supermolecule holding the intramolecular logic gate board and all the lateral chemical group equipping the final molecule to perform on a surface, (5) theory of large molecule surface science including molecular structure extraction for the experimental STM and NC-AFM images.

Pico-Inside integrates the necessary groups to explore new architecture concepts with Fujitsu Europe. LT-UHV-STM and NC-UHV AFM offer a complete and true access to the atomic scale for interconnects with Omicron. This includes nano-stencil contact experiments, the necessary chemistry labs task force and the required theoretical group to support the architecture, the molecular design and the analysis of Pico-Inside nanoscale experiments.

To prepare the future FPX (Framework Programme) of European Research with X = 7 and 8, Pico-Inside will create and diffuse to a broad community original roadmaps for interconnect and nano-communication, for chemistry of supermolecules and for intramolecular computing.

Many of the potential molecular electronic applications still require substantial work in order to be transformed into marketable technology. A concerted effort must be made at the European level to both understand and commercialise atomic scale technology in order to maintain a competitive advantage for Europe. The Pico-Inside Integrated Project and related “dissemination & training” activities will provide both, academic researchers and industry engineers access to the tools needed to keep Europe at the forefront of the next nanoelectronics revolution, a revolution beyond nanotechnology.