CATHERINE: Carbon nAnotube Technology for High-speed nExt-geneRation nano-InterconNEcts

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As described in the 2005 Technology Roadmap for Semiconductors (ITRS) and its updates the continuous miniaturization of electrical and electronic devices, together with the high integration level and the increase of the working frequencies and power density require the use of innovative solutions for the realizations of on chip interconnections and vias in order to avoid in the near future a technological bottleneck.

Traditional interconnect technology will no longer satisfy future performance requirements. Whereas critical dimensions of transistors are now below 100 nm, the widths of interconnects are still on a micron scale. Actually copper, which is nowadays the preferred solution for intermediate and global interconnects, is highly susceptible to electromigration at high current densities and presents lower reliability as the dimensions are scaled to values lower than 100 nm. Moreover, the electrical resistivity of copper interconnects increases dramatically when the cross-sectional dimensions become comparable with the mean free path of the electrons (nearly 40 nm at room temperature) due to the combined effects of scattering from grain boundaries and interfaces. The steep rise in parasitic resistance of copper interconnects poses serious challenges for interconnection delay, especially at the global level, and for interconnect reliability, hence it has a significant impact on the reliability of nano-scale ICT devices and systems.

Unconventional interconnects and innovative materials are being studied as replacements for copper interconnects. Because of their exceptional and unique physical properties carbon nanotubes (CNTs) have aroused a lot of research interest that make them promising candidates as nano-interconnects for future high-speed electronics.

CATHERINE project will develop an innovative cost-effective and reliable technological solution for high-performance next-generation nanointerconnects beyond the limit of current technology. The new approach, which exploits the carbon nanotube (CNT) technology, will permit to realize interconnects with high-transmission speed, high current density, exceptional mechanical and thermal properties, optimum signal and power integrity.

CATHERINE project is focused on delivering cost-effective solution to the ITRS roadmap for late CMOS and post-CMOS systems, requiring continuous miniaturization of electrical and electronic devices (down to 22 nm node in 2011), high integration level, increasing working frequency and power density, reduction of global interconnection delay.

The expected results of CATHERINE are then summarized by the following points:

1. Definition of all causal relations within the design-chain “microstructure characteristics – fabrication process – functional properties”;
2. Development of multiscale multiphysics simulation models for the prediction of the multifunctional performance of the interconnect and for the EMC analysis;
3. Development of electromagnetic and multifunctional test procedures and experimental characterization methods;
4. Manufacturing and testing of proof-of-concept samples of nanointerconnects at laboratory level.

Final CATHERINE products will be an integrated data-base for nanointerconnect design and a proof-of-concept nanointerconnect.

CATHERINE Consortium is described in the table below. The figure shows the Pert's diagram of CATHERINE.

Beneficiary No.	Beneficiary name	Country
1 (Project Coordinator))	Consorzio Sapienza Innovazione	Italy
2 (Scientific Coordinator)	Università degli Studi di Roma "La Sapienza" - Research Centre for Nanotechnology Applied to Engineering	Italy
3	Technische Universiteit Delft – Department of Precision and Microsystem Engineering	The Netherlands
4	Universite Paul Sabatier Toulouse III - UPS	France
5	Università degli Studi di Salerno	Italy
6	Latvijas Universitates Cietvielu Fizikas Instituts	Latvia
7	National Institute for Research and Development in Microtechnologies - *Microphysical Characterisation And Simulation Group*	Romania
8	Swedish Defence Research Agency	Sweden
9	Istituto Nazionale di Fisica Nucleare	Italy
10	Philips Electronics Nederland B.V.	The Netherlands
11	Smoltek AB	Sweden