Carnegie Mellon
Materials Science and Engineering Seminar Series

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"Supramolecular Nano-Materials and Lithography"

Friday, February 5, 2010
11:30 A.M. Seminar in Scaife Hall 125

It is know that specific molecules can spontaneously arrange on various surfaces forming two-dimensional poly-crystalline mono-molecular layers called self-assembled monolayers (SAMs). We will show that when mixed SAMs are formed on surfaces with a radius of curvature smaller than 20 nm they spontaneously phase-separate in highly ordered phases of unprecedented size. In the specific case of mixed SAMs formed on the surface of gold nanoparticles, the molecular ligands separate into 5 Å wide phases of alternating composition that encircle or spiral around the particle metallic core. This new family of nano-structured nano-materials shows properties solely due to this unique morphology, both in terms of fundamental properties such as surface energy and in terms of complex interaction with biological materials such as proteins and cells.

Additionally, it will be shown how patterned DNA SAMs can be used as masters for a novel printing technique for organic materials called Supramolecular NanoStamping (SuNs). This method, like the DNA/RNA information transfer, uses the reversible assembly of DNA double strands as a way of transferring patterns from a surface onto another. One of the main advantages of SuNs is that multiple DNA strands (each encoding different information) can be printed *at the same time*, thus allowing for a complex chemical pattern to be formed, much like Gutenberg movable type.

Francesco Stellacci graduated the Politecnico di Milano in 1998 with a thesis on photochromic materials. He then moved to the University of Arizona as a post-doctoral scholar and worked on two-photon microfabrication of three dimensional metallic structures. In September 2002 he is a faculty in the Department of Materials Science and Engineering at MIT, where he currently is an associate professor.