Spontaneous Formation of Domains on Metal Nanoparticles

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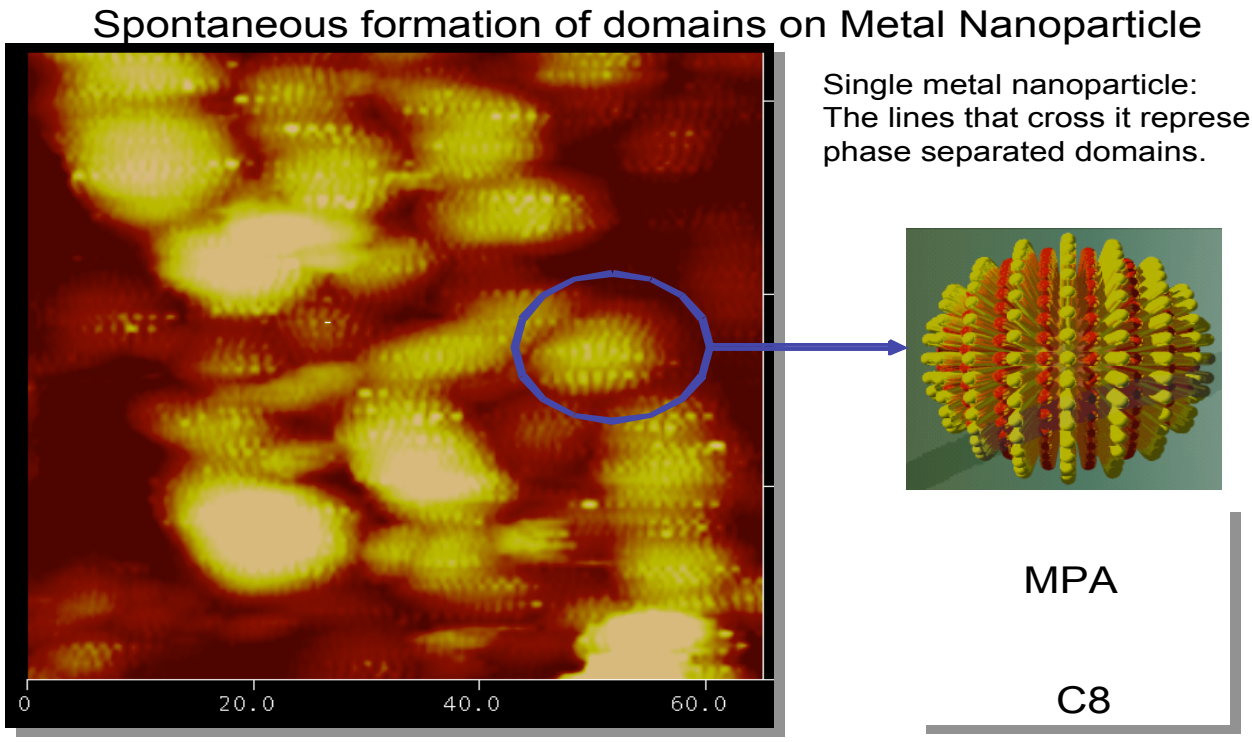
Researchers at MIT have recently found that nano-structured organic molecules on the surfaces of various substrates may exhibit novel specific properties that could be useful in both materials science as well as in biology. Francesco Stellacci and his group of graduate students in the department of Materials Science have investigated a new class of nanostructured nanomaterials that show ordered, phase-separated domains at an unprecedented molecular length scale and prove that novel properties result from this nanostructuring. Indeed, these materials are extremely effective in avoiding protein nonspecific adsorption. Scanning tunnelling and transmission electron microscopy images of monolayer protected metal nanoparticles (MPMNs) with ligand shells composed of a mixture of molecules show that the ligands phase-separate into ordered domains spaced < 1 nm.



What was found is that the same molecules randomly distributed on a surface offer good anchor points for protein non specific adsorption while when they are nanostructured they prevent nonspecific adsorption completely. Similarly solubility is affected profoundly by the nanostructure. Importantly, the domain shape and dimensions can be controlled by varying the ligand composition or the metallic core size. Additionally, here we show that the formation of ordered domains depends on the curvature of the underlying substrate. This investigation is the focus of a recently submitted article to Nature by Stellacci and his research team. Collaborations in this NIRT program with researchers at Wayne State University as well as Georgia Institute of Technology have begun in the form of photophysical investigations of the novel organic/inorganic hybrid systems.