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Directing the assembly of nanostructured films with living cells

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This talk describes our recent discovery of the ability of living cells to organize extended nanostructures and nano-objects in a manner that creates a unique, highly biocompatible nano//bio interface (*Science* **313**, 337-340, 2006). We find that, using short chain phospholipids to direct the formation of thin film silica mesophases during evaporation-induced self-assembly, the introduction of cells (so far yeast and bacteria) alters profoundly the inorganic self-assembly pathway. Cells actively organize around themselves an ordered, multilayered lipid-membrane that interfaces coherently with a lipid-templated silica mesophase. This bio/nano interface is unique in that it withstands drying (even evacuation) without cracking or the development of tensile stresses – yet it maintains accessibility to molecules, proteins/antibodies, plasmids, etc - introduced into the 3D silica host. Additionally cell viability is preserved for weeks to months in the absence of buffer, making these constructs useful as standalone cell-based sensors. The bio/nano interfaces we describe do not form 'passively' – rather they are a consequence of the cell's ability to sense and actively respond to external stimuli. During *EISA*, solvent evaporation concentrates the extracellular environment in osmolytes. In response to this hyperosmotic stress, the cells release water, creating a gradient in pH, which is maintained within the adjoining nanostructured host and serves to localize lipids, proteins, plasmids, lipidized nanocrystals, and a variety of other components at the cellular surface. This active organization of the bio/nano interface can be accomplished during ink-jet printing or selective wetting – processes allowing patterning of cellular arrays - and even spatially-defined genetic modification.