123b Interfacial Engineering of Lipid Nano-Patterns for Controlled Nucleation of Aspirin

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In order to arrange functional units on areas of ever diminishing sizes, it is important to understand the effect of surface chemical heterogeneity on such arrangement. Chemical heterogeneity with a length scale at or below the critical nucleus size can dramatically change the nucleation behavior of the incipient material. This talk describes our recent efforts in engineering nano-patterns at surfaces using lipid and surfactant molecules in order to control the nucleation behavior of organic drug and dye molecules. Lipid molecules, such as dimyristoylphosphatidylethanolamine (DMPE), self-assemble into a bilayer stripe phase on graphite because of the epitaxy match between the alkyl chains of lipid and graphite lattice. The chemical heterogeneity of the nano-pattern can be varied by the headgroup and the tail length of the lipid molecules. Lipophilic aspirin molecules adsorb and aggregate preferentially in the hydrophobic interior region of the DMPE bilayers stripes. AFM captures rod-like aggregates of aspirin in commensurate with the underneath periodic DMPE nano-pattern, but well-defined crystals of aspirin on neighboring bare graphite. The nano-pattern not only directs the deposition and aggregation of aspirin molecules but also changes the crystalline habit of aspirin from rectangular-shaped crystals to rod-shaped amorphous aggregates. Here the nano-confinement of the lipid layer not only provides a defined encapsulation medium but also enhances the solubility and bioavailability of lipophilic drugs.