

MAR11-2010-004050

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Convective microsphere monolayer deposition

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There is perhaps no simpler way of modifying surface chemistry and morphology than surface deposition of particles. Micron-sized microspheres were deposited into thin films via rapid convective deposition, similar to the ‘coffee ring effect’ using a similar method to that studied by Prevo and Velez, Langmuir, 2003. By varying deposition rate and blade angle, the optimal operating ranges in which 2D close-packed arrays of microspheres existed were obtained. Self-assembly of colloidal particles through a balance of electrostatic and capillary forces during solvent evaporation was revealed. These interactions were explored through a model comparing the residence time of a particle in the thin film and the characteristic time of capillary-driven crystallization to describe the morphology and microstructure of deposited particles. Co-deposition of binary suspensions of micron and nanoscale particles was tailored to generate higher-quality surface coatings and a simple theory describes the emergence of instabilities that result in formation of stripes. Optical and biomedical applications that utilize the described nanoscale control over surface morphology will also be discussed.