Dynamics of Discontinuous Coating and Drying of Nanoparticulate Films.

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Heightened interest in micro-scale and nano-scale patterning by imprinting, embossing, and nano-particulate suspension coating stems from a recent surge in development of higher-throughput manufacturing methods for integrated devices. Energy-applications addressing alternative, renewable energy sources offer many examples of the need for improved manufacturing technology for micro and nano-structured films. In this presentation we address one approach to micro- and nano-patterning coating using film deposition and differential wetting of nanoparticles suspensions. Rather than print nanoparticle or colloidal inks in discontinuous patches, which typically employs ink jet printing technology, patterns can be formed with controlled dewetting of a continuously coated film.

Here we report the dynamics of a volatile organic solvent laden with nanoparticles dispensed on the surfaces of water droplets, whose contact angles (surface energy) and perimeters are defined by

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lithographic patterning of initially (super)hydrophobic surfaces. The lubrication flow equation together with averaged particle transport equation are employed to predict the film thickness and particle average concentration profiles during subsequent drying of the organic and water solvents. The predictions are validated by contact angle measurements, in situ grazing incidence small angle x-ray scattering experiments, and TEM images of the final nanoparticle assemblies.