Periodic Uniform Linear Crack Formation During Convective Deposition

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Particulate coatings are highly useful in the fabrication of latex films, nanostructured membranes, and various optical devices. Rapid convective deposition is used to assemble nanoparticle coatings with controllable thickness from suspension. The film thickness is controlled through mechanical means, suspension volume fraction, control of relative humidity, and the use of applied thermal gradients. Varying film thickness generates linear drying stress-induced cracking with highly monodisperse spacing. These cracks extend in the deposition direction, and uniform crack spacing from 2-160 μm is observed. Nanoparticle film thickness generate a relevant hydrodynamic length scale for fluid flow, as shown by Lee and Routh, *Langmuir*, 2004, and films crack in this characteristic manner to minimize system energy and capillary stresses. As expected from this energy minimization problem and relevant theory, the correlation between coating thickness and crack spacing is highly linear.

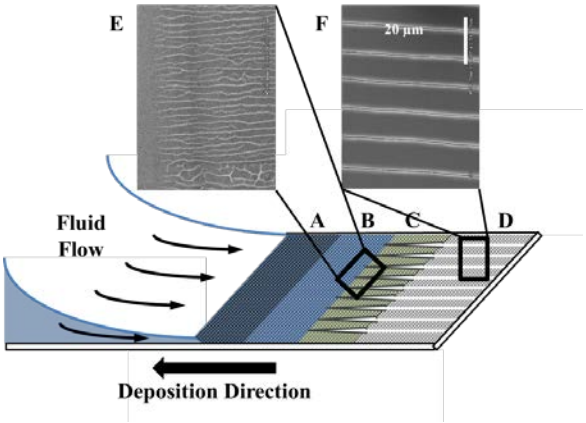

Figure. Downstream from the thin film flow and particle assembly during convective deposition, uniform cracks form with spacing proportional to the film thickness. The cracks are a result of hydrodynamic stresses during drying and agree with previous macroscopic measurements.