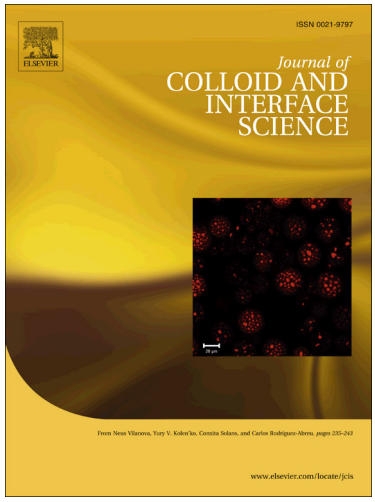

Uniformly spaced nanoscale cracks in nanoparticle films deposited by convective assembly

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Uniformly spaced nanoscale cracks in nanoparticle films deposited by convective assembly

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Abstract

Rapid convective deposition is used to assemble nanoparticle coatings from suspension, with controllable thickness. Varying film thickness generates stress-induced linear cracks with highly monodisperse spacing. Film thickness is controlled through mechanical means, suspension volume fraction, and the use of applied thermal gradients. These cracks extend in the deposition direction, and a uniform crack spacing from 2-160 μm is observed. The nanoparticle film thickness is the relevant length scale for hydrodynamic flow, and films will crack with this spacing, in a characteristic manner to minimize the 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. Because this process is continuous, continuous cracks have potential as a high-throughput method of fabricating nanoscale channels for microfluidics and MEMS.