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Colloidal crystal growth by evaporation-induced convective steering DAMIEN D. BREWER, SATISH KUMAR, MICHAEL TSAPATSIS, University of Minnesota — We simulate evaporation-driven self-assembly of colloidal crystals using an equivalent network model. Relationships between a regular hexagonally close-packed array of hard, monodisperse spheres, the associated pore space, and selectivity mechanisms for face-centered cubic microstructure propagation are described. Accounting for contact line rearrangement and evaporation at a series of exposed menisci, the equivalent network model describes creeping flow of solvent into and through a rigid colloidal crystal. Observations concerning colloidal crystal growth are based on the convective steering hypothesis, which posits that solvent flow into and through the pore space of the crystal may play a major role in colloidal self-assembly. Aspects of the convective steering and deposition of high-Peclet-number rigid spherical particles at a crystal boundary are inferred from spatially resolved solvent flow into the crystal. Gradients in local flow through boundary channels were predicted due to the channels' spatial distribution relative to a pinned free surface contact line. When the free surface contact line is pinned near the leading crystal edge, the network simulations suggest that rows of particles preferentially nucleate furthest from the substrate. These lattice sites propagate the existing microstructure and lead to a declining shelf formation.

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