

Impact of particle-size polydispersity on colloidal crystallization and thin-film structures

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The synthesis of colloids is frequently challenged by the difficulty of producing monodisperse particles. Size disparity in colloidal particles can disrupt order in their assemblies, ultimately leading to a complete suppression of crystallization. In this talk, I will present a systematic experimental investigation into how size polydispersity affects the 2D and 3D structures of colloidal crystals grown as thin films through vertical drying. Surprisingly, we do not observe a gradual decline in 2D local order but two sharp drops at 8% and 12% polydispersity, indicating the presence of both 2D and 3D crystallization regimes in the system. By showing that assembly quality improves from the bottom up, we suggest that 3D crystallization in our system resembles epitaxial growth. We also examine whether this crystallization process involves size fractionation. To broaden the picture, we explore how polydispersity influences crystallization within bulk samples. These insights help define the limits for achieving ordered colloidal crystals and shed light on assembly mechanisms in vertical drying of thin films, where direct observation of the crystallization process is experimentally challenging.

Keywords:

colloids, self-assembly, polydispersity, thin films, crystallization