The effects of polydispersity and metastability on colloidal crystallization

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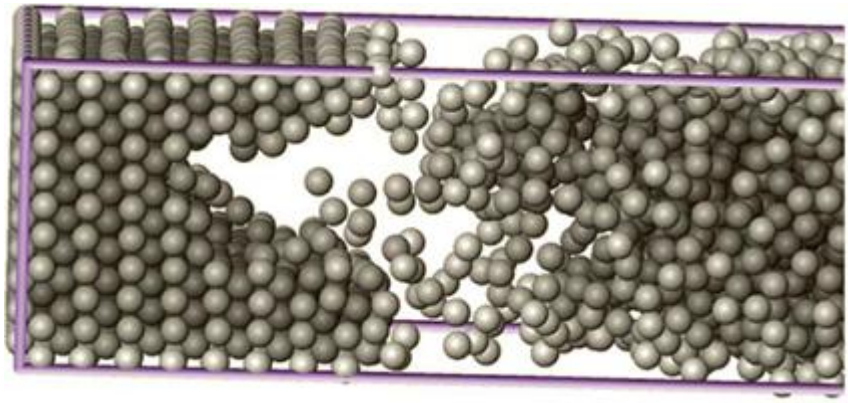
We have performed large-scale simulations of crystal growth in a system of slightly size-polydisperse particles, with important implications for the interpretation of any experiments involving metastability. Our system parameters are such that, in the vicinity of a metastable gas-liquid phase transition, a macroscopic layer of the colloidal-gas phase coats the crystal as it grows (see figure below), consistent with experiments and theoretical free energy considerations.

Crucially, the effect of this metastability on the crystal growth rate depends qualitatively on whether the system is polydisperse. We find a reduction in polydispersity and qualitatively different local size ordering in the crystal relative to the fluid, and propose that the particle-sorting required for crystallization is dynamically facilitated by the gas layer. Our results show that polydispersity and metastability, both ubiquitous in soft matter, must be considered in tandem if their dynamical effects are to be understood [1].



[1] The effects of polydispersity and metastability on colloidal crystallization, J J Williamson and R M L Evans, Soft Matter 9, 3600 (2013)