Aggregation of Heterogeneously Charged Colloids

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Patchy colloids are attractive as programmable self-assemblers. Inverse patchy colloids, where patched areas are attracted to unpatched areas, are additionally interesting as models of heterogeneously charged proteins such as beta-lactoglobulin. Here, we simulate charged colloids with just one patch of the opposite charge in a solution with strong screening. We find a rich set of phases, including ferroelectric crystals and liquids, wormlike aggregates, finite clusters, and gel-like empty fluids. These phases are robust to strong polydispersity in patch shape and size and variations to the potential model.

We also determined the liquid/vapor coexistence for patchy colloids. Adding unpatched charged colloids can either enhance or suppress aggregation depending on patch size and alters the characteristics of the dense phase. These effects can be exploited to control protein aggregation, and as probes for measuring the effective patch size of a heterogeneously charged colloid.

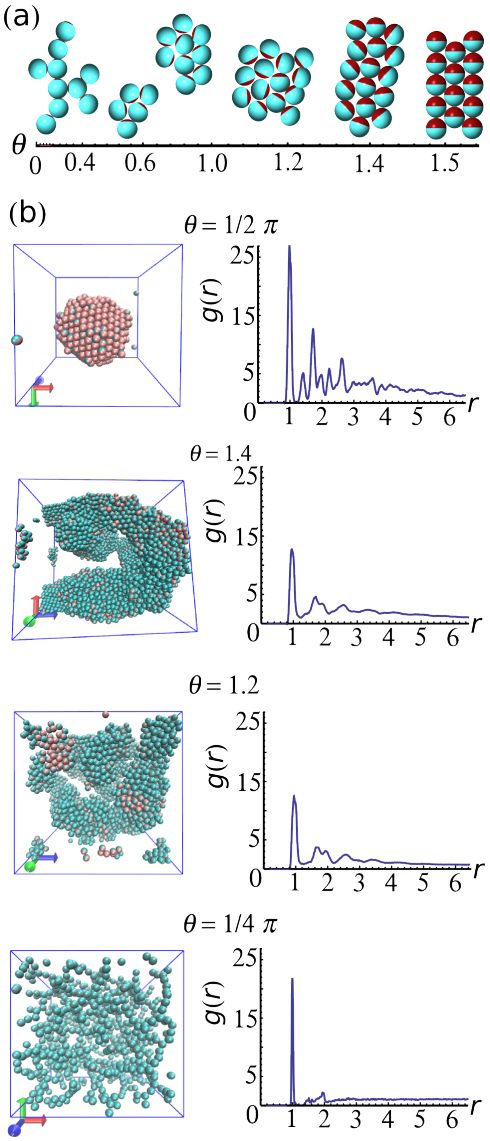

Figure: Cold annealed phases of patchy colloids. (a) Schema of phases as a function of patch opening angle θ. (b) Simulation results for four selected patch sizes. For two even hemispheres of charge, close-packed ferroelectric crystals result. With decreasing patch size, the dense crystals become worms, then finite-sized clusters, and finally empty fluids.

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