Electric Field-Reversible Three-Dimensional Colloidal Crystals

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Because of their size and ability to self-assemble, there has been significant effort in recent years towards the fabrication of photonic materials based on colloidal crystals. To date these efforts have led to a number of systems showing useful optical properties; however, for the most part, these materials remain static and can be difficult to form within reasonable time scales. We show here the fabrication of three-dimensional colloidal crystals that can be quickly and reversibly created through the application of electric fields. Constructed only of submicron-sized colloidal polystyrene in aqueous solution, these crystals are highly ordered, mechanically stable, and capable of diffracting light of visible wavelengths. In addition, we show how crystal nucleation can be directed through control of the spatial distribution of the applied electric field.