Robust and Transparent Colloidal Photonic Crystals for Security Materials

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Colloidal crystals have attracted considerable attention owing to their unique optical properties as 3D photonic crystals. However, conventional approaches such as vertical deposition lack in physical stability and controllability of shape and structure, thereby severely limiting practical usages. In this work, we propose a novel platform to produce robust and controllable colloidal photonic crystals employing photocurable suspension of silica particles. The silica particles are spontaneously crystallized under assistance of shear flow owing to repulsive interparticle potential and the crystal structures are easily solidified through UV-induced polymerization of medium. The resultant colloidal photonic crystals are highly transparent due to low contrast in refractive index between the particles and the medium, enabling the production of multiple layers of photonic crystals and therefore the generation of distinct reflectance peaks. Such multi-colored colloidal photonic crystals are employed as security materials for anti-counterfeiting; structural colors from colloidal photonic crystals are difficult to duplicate and strong and narrow bandwidth of multiple peaks provide high optical selectivity.