Self-Organization of Colloidal Particles in Confining Aqueous Droplets for Photonic Balls

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Recently, we developed the emulsion-based route to creating spherical shaped colloidal crystals or polyhedra. In this case, emulsion droplets provided the geometrical confinement for the self-assembly of colloidal particles. Specifically, colloidal particles in confining droplets are self-organized into colloidal clusters as the droplets are shrunk by slow evaporation of the liquid in droplets. When the number of colloidal particles in a droplet is large, they form a spherical colloidal crystal (or photonic ball) which exhibits an optical stop band for the normal incident light independently of the position all over the spherical surface. In this study, we made monodisperse aqueous emulsion droplets encapsulating colloidal particles in oil phase, and controlled microwave irradiation of the aqueous drop phase created spherical colloidal crystals. Unlike usual colloidal crystals, colloidal crystals in spherical symmetry (or photonic balls) possessed photonic band gaps for the normal incident light independently of the position all over the spherical surface.