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Rapid fabrication of ordered 2D binary colloidal crystals at the air-water interface by engineering the surface properties of water and polymer microspheres

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Abstract
In this work, the fabrication of centimeter-sized 2D binary colloidal crystals, composed of monodisperse poly(methyl methacrylate) (PMMA) microspheres with diameters of 1039 and 238 nm, using the self-assembly method at the air-water interface is studied. In this method, a colloidal suspension of large and small spheres mixed with ethanol is gently injected onto a glass substrate. After injection, the colloidal spheres rapidly spread on the water surface and form a monolayer of polymer microspheres that can be transferred onto any other substrates. A challenging issue in fabricating 2D binary colloidal crystals is the regular penetration of smaller microspheres into the empty spaces between larger ones. It has been shown in this work that the use of sodium dodecyl sulfate (SDS) surfactant and adjusting the pH of water by adding sodium hydroxide (NaOH) leads to ordered penetration of small spheres. Moreover, optimal concentrations of SDS and pH for fabricating large and regular crystals at the air-water interface have been obtained. The fabricated 2D binary colloidal crystals have various applications in different fields, such as photonic devices, chemical/biosensors, chromatography, biomedical devices, cell culture tools etc.

Keywords: 2D binary colloidal crystals, air-liquid interface deposition, self-assembly, monodisperse polymeric microspheres, structural defects

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