

'Elastomeric Opal Polymer Fibres with Stretchable Colour Effects'

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Abstract:

Colloidal photonic crystals such as natural opals consisting of stacked silica spheres, are typically assembled by evaporation techniques to produce rigid, multi-domain crystals. Here we present an alternative, *industrially-scalable* method that produces *flexible, single-domain* opals for structural colour applications. Large-scale self-assembly of opals is achieved by shear-flow alignment of core-shell spheres in a polymer melt to produce crystal samples tens of meters long. Unlike natural opals, crystal domains are aligned in the direction of the shear resulting in uniform colour. Fabrication of the opals requires no solvent and samples have been made by standard extrusion and compression techniques to generate sheets, ribbons and fibres. The opals display bright iridescent structural colours determined by the particle size. The colour can be greatly enhanced in appearance by the addition of small quantities of nanoparticles such as carbon black, which can be easily added during the compounding process. Due to the soft shells of the spherical particles, the opals display rubber-like mechanical properties and can be reversibly stretched by 50%. Stretching or bending the opals changes the lattice spacing and therefore their colour dramatically. The flexibility also makes the opals durable, suitable for a wide range of commercial products.