Contribution ID: **1169** Type: **Invited Speaker / Conférencier invité**

Assembly of Gold Nanoparticles in Blue Phase Liquid Crystals: Towards New Generation of Soft Nanocrystals

Monday 13 June 2016 11:00 (30 minutes)

The use of nanoparticles in the field of nanotechnology is one of the most promising approaches for novel technological applications through the development of reconfigurable ordered structures with rich properties. As well, the coupling of nanoparticles within liquid crystals is an emerging topic in the field of soft matter that offers new possibilities for designing reconfigurable nanomaterials that respond to a wide range of external stimuli. In this work, we report the spontaneous formation of thermally reversible, cubic crystal nanoparticle assemblies in Blue Phases. Gold nanoparticles, functionalized to be highly miscible in cyanobiphenyl-based liquid crystals, were dispersed in Blue Phase mixtures and characterized by polarized optical microscopy and synchrotron small-angle X-ray scattering (SAXS). The nanoparticles assemble by selectively migrating to periodic strong trapping sites in the Blue Phase disclination lines. At the Blue Phase I to Blue Phase II phase transition, the nanoparticle lattice reversibly switches between two different cubic structures. The simultaneous presence of two different symmetries in a single material presents an interesting opportunity to develop novel dynamic optical materials. Recent progress in understanding the mechanism of nanoparticle self-organization is presented.

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Session Classification: M1-5 Soft Matter and Polymers (DCMMP-DPMB) / Matière molle et polymères (DPMCM-DPMB)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)