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Tailoring liquid crystal phase transitions by addition of silica nanoparticles

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Liquid crystals (LCs) are materials with properties typically associated with both solids and melts. These systems possess both the structural order of crystals and the flow properties of liquids. One family of LC is the lyotropic LCs, which are formed by mixing otherwise immiscible solvents, usually with some molecularly anisotropic substance, such as a surfactant. Such systems can form a wide variety of shapes, including hexagonal lattices of cylindrical micelles or repeating sheet-like lamellar structures, and each possesses unique properties. Transitions between these phases can be controlled by various parameters, such as altering the concentration of any substituents, by changing the temperature, or by applying a shear strain.

This study was conducted to determine the effect that adding silica nanoparticles (NPs) can have on the phase transition between different lyotropic LC phases. This work has implications for the application of LC systems as protein crystallisation media, as cellular models, and templates for synthesis. Structures were analysed using polarising light microscopy (PLM), and small-angle x-ray and neutron scattering (SAXS/SANS), with both rheological (rheoSANS) and thermal control.

The results revealed that silica NPs can modulate LC mesophases by altering the thermal and rheological conditions required for phase transition. In one instance, they specifically prevent the formation of a hexagonal LC phase, while in other circumstances they can promote hexagonal phase formation after shear is stopped. This suggests that caution is required when designing LCs to be used as solvents, as any doped particles may affect the resulting phase behaviour. It also suggests the potential application of silica NPs as cryoprotectants, as well as the ability of NPs to customise the shear-response of different LC systems.

Speakers Gender

Male

Travel Funding

Yes

Level of Expertise

Student

Do yo wish to take part in the poster slam

Yes

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