Twist-grain boundary phases induced by spherical nanoparticles

Maja Trček,¹* Vasilios Tzitzios,² George Cordoyiannis,¹,³ Samo Kralj,⁴ George Nounesis,² and Zdravko Kutnjak,¹,⁵

1 Condensed Matter Physics Department, Jožef Stefan Institute, 1000 Ljubljana, Slovenia
2 National Centre for Scientific Research “Demokritos”,15310 Aghia Paraskevi, Greece
3 Department of Physics, University of Athens, 15784 Athens, Greece
4 Faculty of Natural Sciences and Mathematics, University of Maribor, 2000 Maribor, Slovenia
5 Centre of Excellence NAMASTE, 1000 Ljubljana, Slovenia

Twist-grain boundary phases consist of slabs of smectic order separated by grain boundaries that form a regular lattice of screw dislocations. They were theoretically predicted as the liquid-crystalline analogue of the Abrikosov flux vortices in the Shubnikov phase of type-II superconductors [1, 2]. Few years later they were experimentally discovered [3, 4] and more recently observed in pure liquid crystals as well as in their mixtures with chiral dopants [5].

Here we present results, obtained by means of high-resolution calorimetry, X-ray scattering and polarising optical microscopy, on nanoparticle-induced TGB A phase in chiral liquid crystals CE6 and CE8. Spherical nanoparticles (NPs) of CdSe and CdSSe core with a different amount of sulphur have been used. They are surface-functionalised with flexible chains of oleyl amine and tri-octyl phosphine.

The experimental results will be presented for different systems of liquid crystals and NPs and then discussed in the frame of a recently proposed mechanism that accounts for the trapping of NPs in screw dislocations [6,7]. In addition to twist grain boundary phase, it is shown that NPs induce a chiral line liquid phase (NL*) between the TGB A and the cholesteric phases. Preliminary results in mixtures of the same liquid crystal compounds with Au nanoparticles will also be presented.

References:

* presenting author; E-mail: maja.trcek@ijs.si