MAR14-2013-003089

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Edward A. Bouchet Award: Liquid Crystal Nanocomposites: Bulk and Local Structure Due to the Presence of Nanoparticles[1]

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We investigate how liquid crystals order in the presence of diverse nanoparticles. These nanocomposites consisting of liquid crystals and nanoparticles have been studied for their applications in devices, such as photovoltaics and to model biological devices. In particular, we study nanocomposites formed by the smectic phases of calamitic liquid crystals in contact with nanoparticles between 2 and 5 nm in size. We have investigated the structural properties of the liquid crystal both far away from the nanoparticles (in the bulk of the sample) as well as in the vicinity of the nanoparticles. We find that the order of the bulk liquid crystal increases up to a certain weight percent concentration of the nanoparticles. The order is reflected in the current versus voltage curve of the different nanocomposites, but does not fully explain how this charge is transmitted from the liquid crystal to the nanoparticle. The liquid crystal in the immediate vicinity of the nanoparticles is fairly disordered, and the disorder depends on the functionalization of the nanoparticle, or lack of it. This disordered structure seems to reflect the faceting, or the arrangement of the nanoparticle into a faceted structure. Understanding the structure the liquid crystal assumes in the vicinity of the nanoparticles, and how it compares to the bulk structure of the liquid crystals gives us an idea of how electrons, or light are transmitted from the liquid crystal to the nanoparticle and viceversa, and how strong this transmission is. A simple model for the transmission of the electric charge is shown.

[1]NSF-DMR-MRSEC-0520471, NSF-DMR-0906433, a Fulbright Specialist Grant and NSF-OISE-1157589