Nanocomposites and nanomaterials

Electro-conductive properties of ionic metal alkanoate composites with synthesized semiconductor and metal nanoparticles

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Electrical properties of mesogenic cadmium octanoate composites containing semiconductor (CdS), and metal (Au) nanoparticles (NPs) have been studied. Semiconductor CdS spherical NPs (size of 2.5 nm) and Au spherical NPs (size of 20 nm) were chemically synthesized in the thermotropic ionic liquid crystalline phase (smectic A) of cadmium octanoate that was used as nanoreactor. We compared the electrical properties of both clean matrix and nanocomposite to clarify the role of semiconductor CdS NPs and Au NPs with different concentrations and appreciated the quality of new materials. Electrical characteristics at different temperatures, which correspond to the different phase states of the nanocomposites, were obtained. The conductivity of nanocomposites has an activation nature both in anisotropic glassy and smectic A phase. The conductivity of the nanocomposite along the cation-anion layers is by two orders of magnitude higher than that across the cation-anion layers, which confirms anisotropy of different nanocomposites regardless of the phase of material. Increase of the nanoparticles concentration brings additional free charge carriers or increases their mobility. In the smectic A phase, increasing the CdS NPs concentration brings additional traps for the carriers that travel in plane of the cation-anion layers. On the other hand, the nanoparticles deform the cation-anion layers and increase mobility of carriers across the layers. In the smectic A phase, increasing the Au NPs concentration brings additional free electrons that travel in plane of the cation-anion layers and additions mobility of carriers across the layers. In the smectic A phase of nanocomposite with Au NPs covered CdS such nanoparticles creates additional walls for the mobility of carriers in plane of the cation-anion layers and across the layers. Shown that nanoparticles in ionic metal alkanoates stable and well ordered, their size and shape can be controlled. Adding nanoparticles in metal alkanoates gives the opportunity to vary the physical properties of materials such as electro-conductivity.