Doctoral positions
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Thesis supervisor

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Thesis topic : **Composites nanoparticles/liquid crystals for new kinds of photovoltaic devices**

We propose in this PHD to build a new kind of photovoltaic device that is interesting for its potential low-cost but also for the modulations of its properties as a function of temperature and magnetic fields that will become possible thanks to the liquid crystal matrix. Our group at INSP has shown how to strictly orientate ribbon-like networks of grain boundary defects in thin films of liquid crystals [1]. We have also shown that nanospheres or nanorods of gold or semiconductors are confined within these defects and form ordered and self-oriented ribbon-like monolayers [2]. The new device will be based on assemblies of n-type nanoparticles (ZnO) confined in the organised defects of p-type liquid crystals, the aim being in particular to optimise the interfaces between n-type and p-type materials for photovoltaic applications.

Initially, using conventional, non-semiconducting liquid crystals, the doctorate student will create the composite with n-type ZnO nanospheres or nanorods to create ordered ribbons of ZnO nanoparticles able to conduct electrons between two electrodes within a liquid crystal matrix. Combined structural (in particular synchrotron diffraction) and electronic studies will make it possible to link the electronic performance of the devices to the structure of the nanoparticle arrays and the surrounding liquid crystal. Secondly, p-type liquid crystals with oriented defects will be implemented to create composites comprising ribbons of n-type nanoparticles ordered between two electrodes and embedded within the liquid crystal. The combination of structural and electronic measurements, particularly under irradiation, will enable the composites to be optimised as key components of new types of photovoltaic devices. Finally, the activation of the liquid crystal, which is responsible for the presence of defects capable of confining nanoparticles, will be studied. Small temperature changes will be tested to enable defects to be reversibly created or eliminated through the liquid crystal phase transitions, allowing to control composites electronic properties.

[1] D. Coursault et al., soft Matter 12 (2016) 629, [2] S.P. Do et al. Nano Letters 20 (2020) 1598

Type of thesis: experimental.

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