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Nanoparticles-based Liquid Crystals Integrated with Photonic Crystal Fibers

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Liquid crystals (LCs) are materials with an unceasing interest due to their unique properties as: electric field-induced director axis reorientation or a vast range of optical anisotropies. All these properties made LCs to be widely used in LC displays. However, these devices still need an improvement of their electro-optical response times, which are relatively slow compared to electroluminescent devices. Recently, there has been a growing interest in dispersing nanoparticles (NPs) in LCs. Metal NPs can adopt a vast number of structural geometries with an electronic structure. Even a small amount of metallic NPs (gold or silver) should be sufficient to influence both the dielectric anisotropy as well threshold voltage of LCs [1].

One of the promising ideas is to integrate NPs-doped LCs with photonic crystal fibers (PCFs) that may result in significant improved efficiency of electric field tuning. Photonic structures referred as photonic liquid crystal fibers (PLCFs) with highly improved spectral, polarization, and guiding tuning properties were proposed more than 10 years ago [2]. Light propagation in PLCFs is governed by one of two principal guiding mechanisms responsible for light trapping within the core and can be dynamically changed by introducing NP-doped LCs into the air-channels, broadening the applicability of PCFs. It appeared that the use of LCs as an infiltrating material greatly improved optical properties of PCFs, also when doped with NPs [3].

The lecture will discuss the latest experimental results of PCFs infiltrated with nematic LCs doped with metallic NPs. Two types of NPs: titanium NPs and gold NPs and two types of LCs: 6CHBT and 5CB LCs were used to compare an influence of the doping on propagation parameters of the PLCFs and their electro-optical response to external electric field. Such a combination of nanoparticles-based liquid crystals and photonic crystal fibers can be considered as a next milestone in developing of a new class of fiber-based optofluidic systems.

References

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