## Nanooptics and nanophotonics / Microscopy of nanoobjects

# Liquid crystal dispersions of carbon nanotubes: from molecular models to development of functional materials

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Dispersions of carbon nanotubes (CNT) in nematic liquid crystals (LC) are known as promising materials for a number of practical applications. The main problem is that CNTs, which can be homogeneously dispersed in LC media, at concentrations above ~0.05% tend to form quasimacroscopic aggregates. Several ways were proposed for preventing this aggregation, though no attempts were made to assess this process on the level of molecular physics.

A review is presented of our studies of CNT aggregate formation in nematics of different chemical classes by a set of independent experimental methods (microscopy, optical transmission, differential scanning calorimetry, conductivity vs time and voltage, methods of singular optics, etc.). A molecular model was proposed describing interaction of CNTs with formation of aggregates of fractal nature ("S-aggregates"). The experimental results are in good agreement with the theoretical picture. Basing on our understanding of the physical picture of CNT aggregate formation processes, several ways were proposed that would allow suppression of CNT aggregation, thus increasing the time stability of composite nanomaterials based on LC+CNT dispersions. Special attention is paid to "hybrid" dispersions, containing, alongside with CNTs, nanoparticles of different anisometry (e.g., exfoliated plates of montmorillonite-type clays), and to CNT dispersions in cholesteric LC (CLC) of different chemical composition. Also presented are our recent results on CLC+CNT systems, including systems with photoactive components. Application possibilities of such nanomaterials in optoelectronic devices are discussed.