

New Class Materials of Organic–Inorganic Hybridized Nanocrystals/Nanoparticles, and Their Assembled Micro- and Nano-Structure Toward Photonics

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Abstract A π -conjugated organic and polymer nanocrystal (NC) is an intermediate state between a single molecule and the corresponding bulk crystals, the size of which is usually in the range of several tens of nanometers to sub-micrometer. According to the development of so-called “reprecipitation method,” well-defined organic and polymer NCs could be fabricated conveniently, and are expected to exhibit peculiar optoelectronic and photonic properties, depending on size and shape. Actually, linear optical properties such as visible (VIS) absorption (or extinction) and fluorescence emission spectra were found to be remarkably dependent on crystal size, due to thermal softening of crystal lattice in NCs, being different from so-called quantum confinement effect in semiconductor nanoparticles (NPs). Polydiacetylene (PDA) noted in the present research is well known to be one of the most promising candidate organic materials for nonlinear optics (NLO). The apparent enhancement of NLO was confirmed in the layered thin film of PDA NCs. Hybridization of π -conjugated polymer NCs with noble metals on a nanometer scale, i.e., core/shell type hybridized NCs, would open a novel scientific paradigm in optoelectronics, photonics, and so on. In the present chapter, the fabrication techniques of core/shell type hybridized NCs, their characterization, and the evaluation of physical properties are first described, and subsequently ordered array structure of polymer microspheres and spherically encapsulated PDA NCs on a patterned substrate are introduced toward photonic device application. Finally, the future scope in the relevant field will be discussed.

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