Controlled aggregation and photophysical properties in conjugated polymer nanoparticles via solvents and temperature treatment

Ruttayapon Potaï1*, Nisanart Traiphol2, Rakchart Traiphol3,4

1Division of Chemistry, Faculty of Science, Nakhon Phanom University, Nakhon Phanom 48000, Thailand
2Laboratory of Advanced Chromic Materials, Department of Materials Science, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
3Laboratory of Advanced Polymers and Nanomaterials, School of Materials Science and Engineering, Faculty of Science, Mahidol University at Salaya, Phuttamonthon 4 Road, Nakhon Pathom 73170, Thailand
4NANOTEC-MU Excellence Center on Intelligent Materials and Systems, Faculty of Science, Mahidol University, Rama 6 Road, Ratchathewi, Bangkok 10400, Thailand

*E-mail: ruttayaponpota@npu.ac.th

Abstract: This research focuses on detail investigations of solvent and temperature effects on controlling the aggregation and the photophysical properties of poly(3-octythiophene) (P3OT) nanoparticles. The nanoparticles have successfully been prepared by using solvent-nonsolvent system. Chlorobenzene (CRB) and pyridine (PRD), having different local polymer-solvent interaction, are used as solvents. The poor solvent, butanol (BuOH), is added into the polymer solutions to induce the polymer chains into the assembled particle with the variation of chain packing. The photophysical properties of P3OT nanoparticles were investigated by using UV-visible absorption, photoluminescent (PL) and fluorescent lifetime spectroscopy. The aggregation of P3OT nanoparticle results in the red-shift peak in absorption and PL spectra. The aggregates formed in the CRB and PRD systems exhibit rather different absorption patterns. The formation of two aggregate types, non-emissive and emissive species, depends on local packing of P3OT segments. The temperature treatment allows the segmental rearrangement within the nanoparticles as determined by the variation patterns of absorption and PL spectra. Fluorescence lifetime measurement presents various types of emissive species of the nanoparticle. This research shows an easily method to control the photophysical properties of nanoparticles. It is an important aspect to establish knowledge concerning physical properties of nanoparticle for improving technologies.

Keywords: Conjugated polymer; Nanoparticle; Photophysics