

White-emitting Conjugated Polymer Nanoparticles: Tuning Emission via Förster Resonance Energy Transfer in Nanostructures assembled through click reactions

ABSTRACT

In this work, we present the design, synthesis and characterization of water-dispersible conjugated polymer nanoparticles with tunable emission wavelengths for their potential applications in the areas of white organic light emitting diodes and cellular imaging. Blue, green and red emitting polymers carrying azide or alkyne groups are utilized and assembled together through 1,3-dipolar cycloaddition (click reaction) to obtain stable, shape-persistent white-emitting nanoparticles. The emission properties can both be tune by varying polymer concentration and nanostructure design as a result of intimate interactions between the polymers within the nanostructure which facilitate a highly efficient Förster Resonance Energy Transfer (FRET).

For this purpose, four different nanostructured architectures were designed and investigated. In the first method, NPs of donor and acceptor are prepared separately and then mixed physically at certain ratios. The second method involves the formation of homogenous solution of both donor and acceptor polymers in THF followed by formation of NPs from the resulting solution. And in the third and fourth methods, sequentially formed NPs were designed. In the former, donor NPs were core and coated with solution of the acceptor polymer as the outer shell. While the later is quite the reverse where acceptor NPs forms the core surrounded by the donor as the outer shell.

Polymers used in this study are namely, poly[9,9-bis(3-azidopropyl)-9*H*-fluorene-*co*-benzene] (**PFBN3**) which is a blue emitter serves as a donor, while poly[4-(9,9-bis(3-(prop-2-ynyloxy)propyl)-9*H*-fluoren-7-yl)-*co*-(1,4-benzo-{2,1,3}-thiadiazole)] (**PFBT**) a green emitting polymer whose absorbance strongly overlap with the emission of the donor serves as the acceptor. Moreover, red emitting polymers such as poly[(2-azidoethyl)-2-(5-(thiophen-2-yl)thiophen-2-yl)thiophene (**PT**) and Poly[(4-(2-(prop-2-ynyloxy)ethyl)thiophen-2-yl)-*co*-(1,4-benzo{1,2,5}thiadiazole)] (**PBTTH**) were each incorporated into multi-shell nanoparticle design to form white emitting tandem nanoparticles.

The morphology and photophysical properties were investigated by DLS, SEM, TEM and UV-VIS, Steady-State Fluorescence, Time-resolved Fluorescence Spectroscopy respectively.

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