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Photofunctional organic nanoparticles

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Abstract

A Photofunctional organic nanoparticles have inspired growing research interests because of their variability and flexibility in materials synthesis as well as high potentials in the application of optoelectronic devices. Covalent synthesis of such architectures is costly, so we have developed a new route for the synthesis of organic nanoparticles based on ion-association. This method utilizes the formation of water-insoluble ion-pair aggregates in aqueous phases by association of a chromophoric ion with a hydrophobic counterion to fabricate organic nanoarchitectures. We here report the synthesis/property of highly fluorescent organic dye nanoparticles with various particle sizes and colors based on ion association.

A blue-fluorescent cyanine dye (BFD) is used as a photofunctional material for the nanoparticle synthesis. In comparison with the dye in water, the BFD nanoparticles show a significant increase in their fluorescence. The fluorescence also increases with a decrease in the nanoparticle size, resulting in a high quantum yield of about 0.8. The observed intense fluorescence is found to originate from a combined effect of restricted “intramolecular” rotation and “intermolecular” H-aggregation of BFD. Additionally, we combine a FRET (Förster resonance energy transfer) concept with the ion-association approach to obtain photofunctional (fluorescent) organic nanoparticles having multi-color emission tunability. Upon addition of a dopant molecule in the BFD nanoparticle, the emission color changed from bluish to reddish or whitish. Note that the pure dopant exhibits red emission. We believe that organic nanoparticles of a binary dye system fabricated using the ion-association method are able to have tunable emission with high fluorescence quantum yields or “mega” Stokes shift.

Biography

Hiroshi Yao has earned his Ph.D in chemistry from Hokkaido University, Japan. He has been an associate professor of University of Hyogo since 1999. His current research interests include fabrications of metal (inorganic) or organic nanoparticles with interesting optical/chiroptical properties. He has published more than 100 papers in reputed journals and books.