2nd International Conference on

Past and Present Research Systems of Green Chemistry

September 14-16, 2015 Orlando, USA

Properties of green solvents and their application in Green Chemistry

Buxing Han
Chinese Academy of Sciences, China

Green solvents, such as supercritical fluids (SCFs) and ionic liquids (ILs), have many unusual properties for developing green and efficient chemical processes. Efficient utilization of green solvents is an important topic in green chemistry. In recent years, we are very interested in physicochemical properties of green solvents and their applications in green chemistry, which include mainly: 1) Phase behavior and intermolecular molecular interaction in complex SCFs, ILs,CO2/IL systems; 2) Effects of phase behavior and intermolecular interactions on the properties of chemical reactions in SC CO2, ILs and CO2/ILs; 3) Colloid and interface science of green solvent systems, including chemical thermodynamics, microstructures, and functions. In this presentation, I would like to discuss some recent results.

hanbx@iccas.ac.cn

DNA-based solar cells: Towards environmentally responsible approaches for solar light harvesting

Challa Vijaya Kumar
University of Connecticut, USA

Solar light harvesting using green methods is a major current challenge. Our approach has been to use biological soft materials for this purpose. Toward this goal, we now report the self assembly and successful construction of DNA-based artificial light antenna systems that capture visible light from 350-600 nm and emit efficiently in the red region of the spectrum. Our strategy has been to self assemble protein-DNA complexes and then embed organic dyes in these biological matrices such that each dye molecule is self assembled in a pre-determined site in the protein-DNA complex. The dye-dye interactions are minimized and each dye is assembled as an isolated molecule in the protein-DNA matrix, yet each dye is able to efficiently transfer energy to other dyes. For example, four different kinds of donor-acceptor dyes have been assembled in these self-assembled matrices and these dyes undergo cascade-energy transfer from the highest energy donor to the lowest energy acceptor via two different jumper dyes. Thus, a 3-step energy cascade has been established with a very high overall efficiency. These are the very first 4-dye cascade systems and these are also the very first antennas that utilize protein-DNA assemblies for the antenna construction. Mechanistic studies show that multiple donor excited states are coupled with multiple acceptor states, thus promoting high efficiency energy transfer from the highest energy donor to the lowest energy acceptor via jumper dyes.

challa.kumar@uconn.edu

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