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場 所： 広島大学 理学研究科 C212 会議室

講演題名

Reversible Photoreduction and Energy Transfer of Perylene Diimide Dyes

講師

Dr. Wade N. Sisk

（Morgan State University, Baltimore, USA）

Due to their excellent chemical, photo, thermal, and weather stability as well has high luminescence intensity perylene diimide (PDI) dyes have found use in optics/opto-electronics including energy transfer dye lasers, solid-state dye lasers, optical amplifiers, luminescent solar concentrators for organic solar cells, luminescent converters for blue LEDs (OLEDs), and electron transport materials for photovoltaics. A retrospective and prospective vision of the author's research into perylene diimide (PDI) dye reversible photoreduction and energy transfer will be discussed over three time periods.

2006 – 2008 (University of North Carolina Charlotte / Shinshu University)

The apparent photodegradation of polymer-dispersed PDI dyes (Perylene Red and Perylene Orange) under both aerobic and anaerobic conditions is investigated by noting the decrease in fluorescence as a function of 532 nm laser pulses. Pulsed-irradiation of these PDI/polymer films under anaerobic conditions demonstrated a recovery of fluorescence, once exposed to oxygen in the absence of irradiation. This suggests reversible photoreduction as the mechanism under anaerobic conditions. Under aerobic conditions, the observation of $^3O_2 \leftarrow {}^1O_2$ 1270 nm phosphorescence suggests Type II photooxidation as a contributing mechanism to PDI photodegradation.

The energy transfer from PDI donor dyes to acceptor dyes dispersed in a polymer was investigated by measuring the fluorescence enhancement of the acceptor dyes as a function of PDI concentration following 532 nm excitation of PDI. These 3-component mixtures also exhibited the same photoreduction and photooxidation characteristics under anaerobic and aerobic conditions respectively. Förster critical radii, energy transfer efficiency and energy transfer rate constants were determined.

2008-2018 (PDI Reversible Photoreduction by Other Groups)

Several papers published on the apparent reversible photodegradation of polymer-dispersed dyes (perylene diimide, substituted aminoanthroquinones, rhodamines) suggest reversible photoreduction as the underlying mechanism, although a photothermal mechanism is also suggested.

2018 – (Morgan State U. / Shinshu U.)

Proposed studies now underway will record the absorbance spectra of PDI/polymer dyes for direct observation of anion peak growth. It is also proposed to carry out such studies on oxygen free sealed PDI/polymer films to better characterize the photoreduced polymer-dispersed PDI dye.

世話人 和田 真一 理学研究科 物理科学専攻（内線 7401）