Open Talk

4th July, 2019 **3:00 PM** **Fermion Hall**

SPEAKER

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TITLE OF THE TALK

"Excitation Dynamics in Organic Nanoaggregates"

ABSTRACT

Faster exciton migration is a primary requirement for efficient energy migration and transfer in photosynthetic reaction centers and also for better efficiency in optoelectronic devices. Phthalocyanines and metallophtalocyanines have been established to be important classes of compounds because of their very special electronic properties and high thermal and chemical stability, which promise potential applications in optical memory devices, nonlinear optics, photovoltaics and many others. Phthalocyanines form nanoaggregates in water because of their poor solubility and strong hydrophobic interactions. We have explored the photophysical and optical properties of the nanoaggregates of phthalocyanine (PC), naphthalocyanine (NPC) and their Zn complexes, namely, ZnPC and ZnNPC and compared the dynamics of excitons created in these nanoaggregate matrices. We find longest diffusion length of exciton in the case of ZnNPC nanoaggregate. Longer diffusion length of exciton is a consequence of higher diffusion coefficient and larger hopping or migration rate of excitons in ZnNPC and is attributed to extended π-conjugation and participation of zinc atom. This study leads us to conclude that ZnNPC nanoaggregate should be a better choice for fabricating more energy efficient devices as compared to other materials studied here.

Anthracene nanoaggregates (NA), synthesized using well known reprecipitation method, have shapes of nanodiscs with the average diameter and height of about 260 nm and 50 nm, respectively. Following photoexcitation of the anthracene nanoaggregate, we have observed population of two different types of singlet excitonic states, namely, free exciton and self-trapped exciton or excimeric state. Our investigation reveals that the presence of defect conditions in the molecular aggregates reduce the free exciton lifetime and slows down the exciton diffusion process marginally. Both the exciton diffusion coefficient and exciton diffusion length in the nanoaggregate and in crystals are comparable. Comparable values of the diffusion lengths in the case of the singlet exciton in the nanoaggregate and crystals suggest that the nanoaggreagates may also be considered as materials for efficient optoelectronic and photovoltaic devices.

Anthracene nanoaggregates, singly or multiply doped with perylene, tetracene, and pentacene, have been synthesized using reprecipitation technique. Following photoexcitation of anthracene molecule in the nanoaggregate, anthracene exciton transfers energy to the dopant molecule(s). Energy transfer (ET) efficiency of about 90 - 98% could be achieved with 10-3 M concentration of the acceptors. Very fast energy transfer rates (~3−6 × 1011 dm3 mol−1 s−1) observed here could be explained by very fast exciton diffusion. Using those three dopants with proper concentration ratios, efficient white light emission has been achieved following optical excitation of the nanoaggregate sample at the absorption band of the anthracene molecule.

HOST FACULTY

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