Yale Institute for Nanoscience and Quantum Engineering

# Friday- May 6, 2016

## 12:00 to 1:00 p.m.

## BECTON SEMINAR ROOM

**Light lunch will be served at 11:45 a.m.**


## Tenghooi Goh

Department of Chemical & Environmental Engineering, Yale University


**"Quaternary Multi-Donor Organic Solar Cells"**

Organic solar cells (OSC) offer great potential in lowering material and production costs for the proliferation of photovoltaics. However, OSC generally suffer from low efficiencies to meet commercial application standards. In Yale TMD lab, we realize the first highly efficient quaternary blend solar cells that break efficiency above 10% – by blending complementary squaraine small molecules and polymer (multi-donor) in the active layer. Compared to the conventional binary architectures, our quaternary systems are enhanced both optically and electronically by energy transfer mechanism and co-crystallinity morphology with PTB7 copolymer as the host material. Furthermore, the same strategy achieves great success in improving the performances of both PT8 (a high open circuit voltage compound) and PTB7-Th (a high current density polymer) systems. In summary, we demonstrate that our multi-donor systems possess significant advantages in (i) widening light absorption window, (ii) improving surface and active layer morphology, (iii) promoting co-crystallization and denser packing structures, (iv) inducing multiple energy and charge transfer pathways to reduce recombination, and (v) enhancing charge mobility. Our findings also indicate that such approach can be utilized to increase the efficiency of complex OSC systems, as well as perovskite solar cells for future applications.


## Sungwoo Sohn

Department of Mechanical Engineering & Material Science, Yale University


**"Nanoscale Size Effects on Crystallization Kinetics of Metallic Glass Nanorods by *In-Situ* TEM"**

Metallic glasses (MGs) provide ideal material platforms to study crystallization due to their simple metallic bonds and slow crystallization kinetics. But even for MGs, a direct observation of the crystallization process has been challenging, partly due to limitations in fabricating samples appropriate for characterization methods. We have recently demonstrated fabrication of metallic glass nanorods via thermoplastic forming, enabling us to directly observe crystallization using a transmission electron microscope (TEM). Here, we investigate crystallization of MG forming liquids by in-situ heating size-controlled MG nanorods down to ~5 nm inside a TEM. We show that the MG nanorod diameter affects the crystallization kinetics strongly. With decreasing nanorod diameters, crystallization temperature decreases initially, exhibits a minimum at ~ 30 nm, and then rapidly increases with decreasing size. In this talk, I will discuss this unusual crystallization kinetics. Factors are experimentally verified by slowed grain growth and scatter in crystallization temperature with decreasing diameters.

**Host: Professor Eric Altman**