Title: Exciton Dissociation and Recombination in Organic Solar Cells (OPVs) and Organic Light-emitting Diodes (OLEDs)

Speaker:
Professor Qunliang Song
Department of Physics,
Southwest University,
Chongqing, China

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Abstract:
Excitons, the bounded electrons and holes, are commonly encountered both in organic solar cells (OPVs) and organic light-emitting diodes (OLEDs) due to the electron localization property of organic semiconductors. Free carriers are obtained in OPVs from excitons first before they are collected by electrodes, while excitons are formed in OLEDs before they can emit light. Here we demonstrate that both exciton recombination and dissociation are competing processes in OPVs and OLEDs. To gain electricity from organic solar cells, which is often called "excitonic solar cell", free carriers from the excitons must be achieved first by dissociation or recombination at interfaces. When excitons reach or form at an interface between two different organic materials, they can be dissociated by transfer of a charge to the second material, leaving behind an opposite charge in the first material. A distinct feature of these interfaces is that both the highest occupied molecule orbital (HOMO) and the lowest unoccupied molecule orbital (LUMO) are higher in one material than in the other (type-I energy alignment). If both the HOMO and the LUMO are lower in one material than in the other (type-II energy alignment), which is opposite the type-I energy alignment, free carrier from excitons can be achieved through recombination of excitons at interfaces. This is realized by recombination of electrons in one material with holes in another material, freeing the holes in the former material and electrons in the latter material respectively. In OLEDs, electrons and holes are forced to inject from cathode into LUMO of electron transport layer and holes from anode into HOMO of the hole transport layer, respectively, and then formed excitons to emit light. Our experiments show that exciton dissociation does exist in OLEDs.

Biography of the speaker:
Qunliang Song is Professor of Physics at Southwest University, Chongqing, China since 2008. Prior to his current position, he worked in Nuclear Power Institute of China for more than 6 years. He received a B.S. degree in Nuclear Physics from Sichuan University, Chengdu, China and the Ph.D. in Condensed Matter Physics from Fudan University, Shanghai, China. He got the world prestigious Lee Kuan Yew Postdoctoral Fellowship in Nanyang Technological University, Singapore. He has been active in the area of clean energy, especially organic solar cells for about 10 years and has been a contributor for more than 40 peer-reviewed journal papers and four Chinese patents. His current research involves study of the new type of organic solar cells, supported by the National Natural Science Foundation of China and the Program for New Century Excellent Talents in University, Ministry of Education, China.

Organizer: Dr. W.C.H. Choy