Molecular doping is an effective tool to enhance bulk conductivity, increase carrier injection and de-activate electron or hole traps in organic molecular and polymer semiconductors. Considerable effort has therefore been directed toward the synthesis of powerful and stable p-type and n-type molecular dopants over the past decade.[1,2] This talk reviews a range of molecular redox agents used in organic electronics, with focus on strong reductants and oxidants for organic semiconductors with low electron affinity (EA) and large ionization energy (IE), respectively. In particular, we look at air-stable dimers, e.g. \([\text{RuCp}^\ast\text{Mes}]_2\), formed of 19-electron organometallic sandwich compounds able to reduce organic semiconductors with EA well below 3 eV.[3] We also look at powerful single-electron molecular oxidants, e.g. \(\text{F}_6\text{-TCNNQ}\) and \(\text{CN}_6\text{-CP}\), with EA larger than 5.6 eV. The second part of the talk focuses on three applications of some these dopants at organic and perovskite surfaces and interfaces: (i) n-doping of electron injection and transport materials (POPy2 and F8BT, EA < 2.7 eV) used in green or blue OLEDs; (ii) surface n-doping of single-layer graphene, resulting in a reduction of its work function to ~2.6 eV, and enabling electron injection in POPy2 (EA = 2.2 eV) [4]; and (iii) the use of these molecular dopants as probes and modifier agents of surface gap states occupation and band bending at metal halide perovskite surfaces.


Host: Pabitra Nayak
Audrey Wood Room, Clarendon Building