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Interface Energetics and Chemical Doping of Organic Electronic Materials

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The energetics of organic semiconductors and their interfaces are central to the performance of organic thin film devices. The relative positions of charge transport states across the many interfaces of multi-layer OLEDs, OPV cells and OFETs determine in great part the efficiency and lifetime of these devices. New experiments are presented here, that look in detail at the position of these transport states and associated gap states and electronic traps that tail into the energy gap of organic molecular (e.g. pentacene) or polymer (P3HT, PBDTTT-C) semiconductors, and which directly affect carrier mobility in these materials. Disorder, sometime caused by simple exposure to an inert gas, impurities and defects are at the origin of these electronic gap states. Recent efforts in chemical doping in organic semiconductors aimed at mitigating the impact of electronic gap states are described. An overview of the reducing or oxidizing power of several n- and p-type dopants for vacuum- or solution-processed films, and their effect on the electronic structure and conductivity of both vacuum- and solution-processed organic semiconductor films is given. Finally, the filling (compensation) of active gap states via doping is investigated on the electron-transport materials C_{60} and P(NDI_2OD-T_2), and the hole-transport polymer PBDTTT-C.