Photovoltaic & Exciton Dissociation at the Nanoscale

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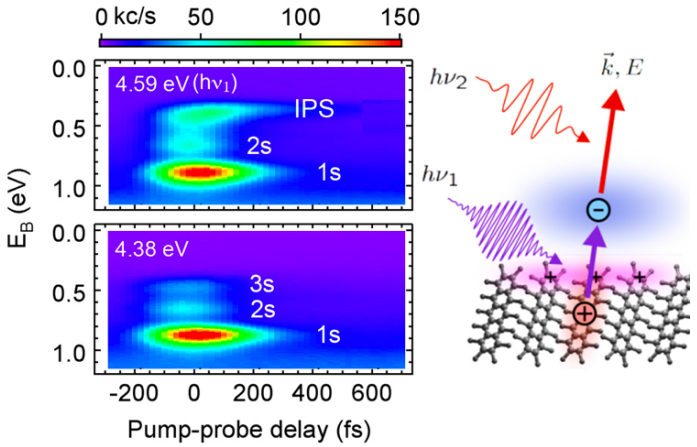
NNIN Facilities utilized: Characterization Facility & Nanofabrication Center

λ DESCRIPTION OF WORK

- Probing charge transfer excitons at organic semiconductor donor/acceptor interfaces
- Electronic energy alignment at quantum dot (QD) & wide bandgap semiconductor interfaces
- In situ optical spectroscopy of organic electronic/optoelectronic devices.



Pseudo color plots of Time-resolved two photon photoemission spectra at different pump-probe delay times for a ~20 nm thick polycrystalline pentacene thin film grown on Si(111). The binding energy scale is referenced to the vacuum level. At $h\nu_1$ = 4.38 eV (lower panel), the 1s, 2s, & 3s CT excitons are clearly resolved. When $h\nu_1$ is increased to 4.59 eV, the delocalized image potential state (IPS) is also observed.

λ MAJOR OBSERVATIONS

- Hot charge transfer excitons must be involved in organic heterojunction photovoltaic.
- Electronic energy alignment at CdSe QDs and ZnO crystalline interface can be controlled by QD size.
- High doping level in polythiophene transistor gated with an electrolyte dielectric can induce an insulator-to-metal transition.

λ Publications

- T. Mills, L. Kaake, X.-Y. Zhu, Appl. Phys. A 95 (2009) 291-296
- X.-Y. Zhu, Q. Yang, M. Muntwiler, Acct. Chem. Res. 42 (2009)
- L. Kaake, X.-Y. Zhu, J. Phys. Chem. C 112 (2008) 16174–16177.
- M. Muntwiler, Q. Yang, W. A. Tisdale, X.-Y. Zhu, Phys. Rev. Lett. 101 (2008) 196403.
- B. Carlson, K. Leschkies, E. Aydil, X.-Y. Zhu J. Phys. Chem. C 112 (2008) 8419-8423.