Charge Delocalization and Transport in Conjugated Molecules: "Molecular Wires" for Photovoltaics?

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Long, conjugated molecules can act as semiconducting “molecular wires.” They appear to have enormous potential for development of inexpensive solar photovoltaics. A field called “plastic solar,” has created solar cells having efficiencies reaching 5%. We will argue that popular methods make little use of the potential of conjugated molecules to act as “wires,” due in part to our limited understanding of what that potential is. Past difficulties with transport confines peoples’ thinking. Limitations on transport, particularly for excitons, are almost seen as absolute, although no fundamental basis is known for such a belief. Experiments described here seek to understand started how fast charges and excitons move in conjugated molecules and whether there are limits to the distances they move without trapping. The experiments inject electrons or photoexcite long, conjugated molecules having charge or exciton traps at the ends using Brookhaven’s Laser Electron Accelerator Facility (LEAF).

LEAF is also used to investigate electron transfer reactions of small molecules and their radical ions. Two applications are determination of redox potentials of molecules that are difficult to reduce and electron transfer by excited radical ions.