Harvesting Energy with Semiconducting Single-walled Carbon Nanotubes

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Semiconducting single-walled carbon nanotubes (s-SWCNTs) are promising materials for efficiently harvesting infrared radiation. Relatively narrow bands of NIR radiation can be harvested through absorption in diameter-tunable excitonic solar cells.[1,2] Alternatively, broad ranges of thermal energy (e.g. waste heat) can be harvested in SWCNT thermoelectric materials. In this talk, I will discuss our fundamental opto-electronic studies of thin s-SWCNT films with highly tunable electronic properties. I will first discuss time-resolved spectroscopic studies of exciton dissociation at s-SWCNT:fullerene Type II heterojunctions. We have measured ultra-fast (< 100 fs) photoninduced electron transfer across such interfaces, with trap-mediated recombination occurring on much slower (ns – μs) time scales.[3,4] Such studies provide insight into potential routes towards the development of efficient thin-film organic photvoltaics based on s-SWCNTs. Next, I will discuss electrical and thermal transport in s-SWCNT films with tunable electronic structure. Fine-tuning the s-SWCNT diameter distribution and carrier density allows us to find optimal ranges for the electrical conductivity, thermopower, and thermal conductivity. These studies provide crucial fundamental insights into the potential for SWCNTs in efficient energy harvesting devices.

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(3) Bindl, D. J.et al. *J. Phys. Chem. Lett.* **2013**, *4*, 3550-3559.
(4) Dowgiallo, A.-M.et al. *ACS Nano* **2014**, *8*, 8573-8581.