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Charge and Energy Transport in Molecular Junctions

PRAMOD REDDY, University of Michigan

Charge and energy transport in molecular junctions, created by trapping short organic molecules (∼1nm) between inorganic electrodes, is expected to be fundamentally different from transport in bulk materials due to their discrete electronic structure. In fact, numerous computational studies have suggested that it may be possible to utilize the novel thermoelectric and thermal transport phenomenon in nanoscale molecular junctions to create efficient energy conversion devices (e.g. thermoelectric devices). However, a large number of these effects remain to be experimentally verified. We will describe our experimental studies where thermoelectric properties of junctions were studied at the single/few molecule level enabling novel insights into the relationship between molecular structure and the thermoelectric properties of junctions. We will also present our recent experimental efforts to probe thermal transport in nanoscale molecular junctions and point contacts. In order to accomplish this goal, it is necessary to accurately measure heat currents as small as 10 picowatts. Towards this goal, we will present a novel device developed by us that is capable of resolving heat currents as small as 4 picowatts.