Hidden information educed from electron spectroscopy: carrier-resolution ultra-low mobility of nanochannels

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As the channel lengths of electronic devices scale down to the nanometer range, conventional methods of charge-carrier mobility evaluation encounter technical limit imposed by various measurement-related interfering effects. Here, we show that electron spectroscopy offers additional (yet hidden) information of unipolar charge transport free from conventional problems. To maintain charge-neutral conditions during electron (photon) beam irradiation, the sample current is sensitively affected by transport properties of the sample, and allows sufficiently precise carrier-resolved mobility for measuring in the extremely low regime (10^{-4} $cm^2/V{\cdot}s$) of nanometer-length channels. Our contactless method enables separate *in-situ* evolution of electron and hole mobilities and is expected to offer a new pathway for probing the nonlocal conduction of spin charges in spin-momentum locked materials.

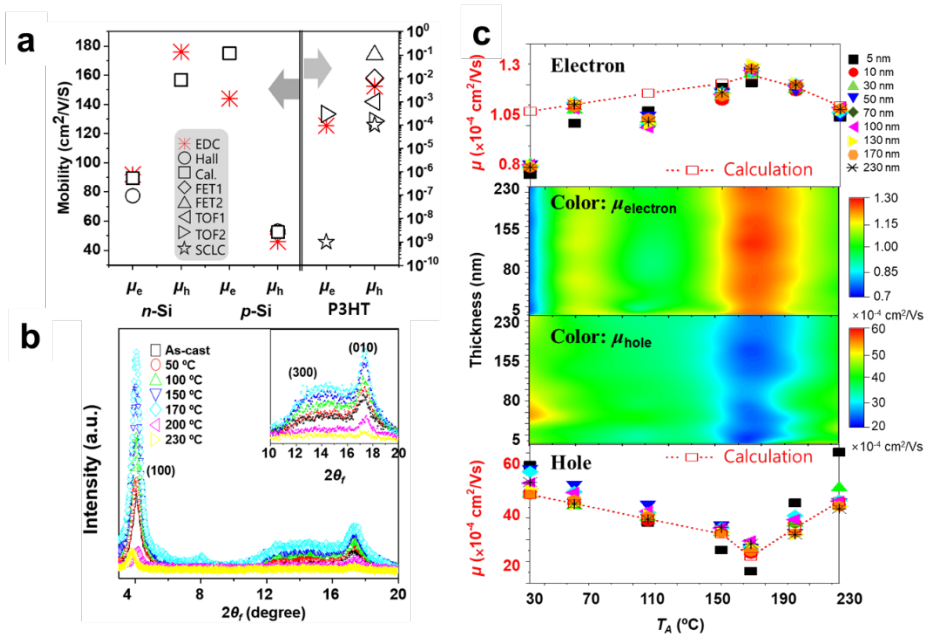

Fig. 1. **Extremely low charge-resolved mobility by EDC methos: (a)** EDC mobilities of standard samples (b In-plane scattering profiles of as-cast and annealed P3HT (c) A two-dimensional graph of the EDC mobility of electrons and hole.