Transport Properties of Organic FETs Modified by Quantum Dots
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NNIN Facilities utilized: Nanofabrication Center & Characterization Facility

● Description of Work
  - We introduced a quantum dot layer between the organic semiconductors and the dielectrics of organic FETs (OFETs) to investigate the effect of disorder.
  - Optical photolithography, e-beam evaporation and reactive ion etching in the NFC were used to fabricate the devices.
  - Scanning electron microscopy in the CharFac was used to characterized the quantum dots.
  - Transport studies were carried out with a Quantum Design PPMS®.

● Major Observations
  - Metal (Au) and insulating (Ag₂O) quantum dots were successfully fabricated. The average dot size was around 50 Å and the dot density was approximately 1.8x10¹² /cm².
  - An insulating dot layer decreased the mobility of the OFETs, suggesting that OFET mobility will always be reduced by additional physical disorder.
  - A metal dot layer caused a much larger reduction of the mobility. This phenomenon may be explained by more charge being induced on metal dots causing the carriers to be more localized.

Figure. 1 (a) Schematic structure of an OFET modified by quantum dots. V_{SD}, V_{G}, S and D denote source-drain voltage, gate voltage, source and drain contacts, respectively. (b) An SEM image of Au quantum dots. The white bar is 10 nm.

Figure. 2 (a) The transfer characteristic of tetracene single crystal organic FETs with/without a layer of Ag₂O dots. (b) The transfer characteristic of tetracene single crystal organic FETs with/without a layer of Au dots. These data were taken with V_{SD} = -20 V at a temperature of 300 K.

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