# 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®.

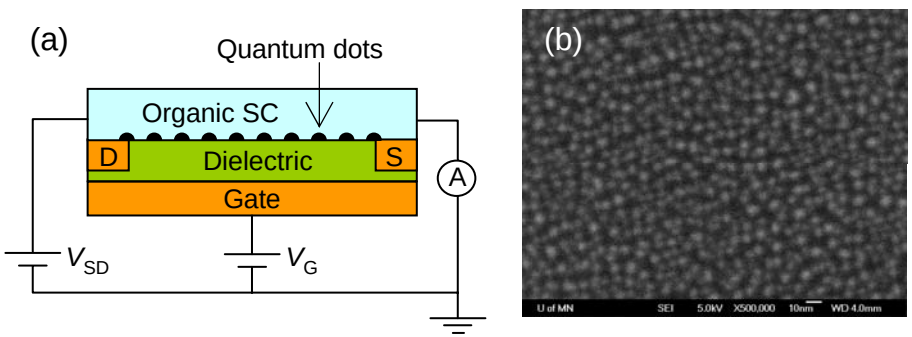


Figure. 1 (a) Schematic structure of an OFET modified by quantum dots. $V_{SD}$, $V_G$, S and D denote source-drain voltage, gate voltage, source and drain contacts, respectively. (b) An SEM image of Au quantum dots. The white bar is 10 nm.

## Major Observations

- Metal (Au) and insulating ($Ag_2O$) quantum dots were successfully fabricated. The average dot size was around 50 Å and the dot density was approximately $1.8 \times 10^{12}$ /cm$^2$.
- 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.

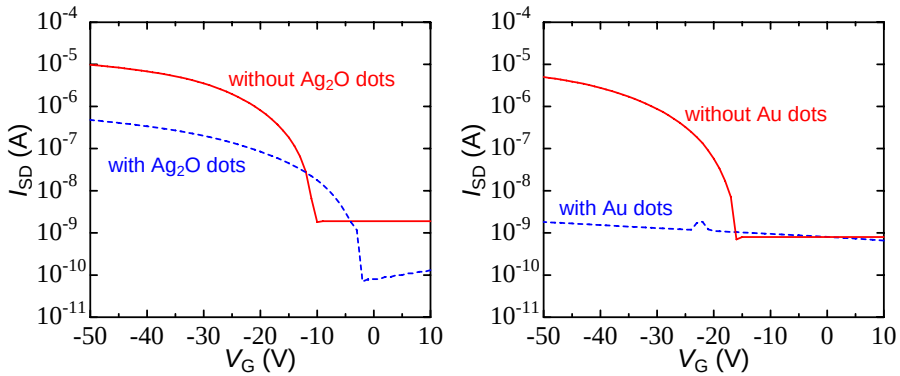


Figure. 2 (a) The transfer characteristic of tetracene single crystal organic FETs with/without a layer of $Ag_2O$ dots. (b) The transfer characteristic of tetracene single crystal organic FETs with/without a layer of Au dots. These data were taken with $V_{SD}$ = -20 V at a temperature of 300 K.

## Publications

- Masaya Nishioka, Yu Chen, and A. M. Goldman, Appl. Phys. Lett. accepted, 2008.