High performance organic electronic devices using carbon nanotube electrodes*

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Abstract

Due to large interfacial contact barrier, one of the major challenges in the fabrication of high performance organic electronic devices is inefficient charge injection from metal electrode into organic semiconductors (OSC). One potential key step of improving the charge injection in the organic devices is to employ signal walled carbon nanotubes (SWNT) as electrodes. Here, we will present our recent progress in fabricating high-performance pentacene and P3HT organic field effect transistor (OFET) using densely aligned SWNT array electrodes. The room temperature electronic transport measurements of the devices show excellent transistor properties with field effect mobility and current on-off ratio are higher than that of the control devices fabricated with gold electrodes. In particular, I will show that our short channel pentacene OFET have highest mobility, on-off ratio and cut-off frequency for any sub-micron pentacene OFETs reported to date. Using low temperature transport measurement, I will discuss charge injection mechanism at carbon nanotube electrode – OSC interface and show that there is a transition from thermionic emission mechanism to tunneling with lowering of temperature. Using Richardson-Schottky model of thermionic emission, we extract a low barrier height for the SWNT-pentacene interface.

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