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Solution-Processable Organic Semiconductors and Conductors: Viable Materials for Functional Thin-Film Transistors[1]

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Large-area displays based on organic materials promise low-cost fabrication, lightweight construction, mechanical flexibility and durability. To truly realize the low-cost aspects of organic electronics, however, conventional high-vacuum deposition technologies will have to be replaced by solution processing methodologies. This need has in turn driven the development of solution-processable organic semiconductors and conductors. We have focused on fabricating thin-film transistors with triethynylsilyl antradithiophene (TES ADT), a solution-processable p-type organic semiconductor. Subjecting the as-cast thin films of TES ADT to short solvent vapor annealing dramatically increases the device characteristics: we observe three orders of magnitude increase in carrier mobility and current on/off ratio, and a decrease in current hysteresis and threshold voltage. The improvement in the electrical characteristics can be directly correlated with morphological transformations during solvent vapor annealing. Our efforts in solution-processable organic conductors focus on water-dispersible polyaniline (PANI). We have fabricated bottom-contact thin-film transistors with PANI electrodes, which function as effectively as gold electrodes, when on-characteristics are concerned. Examination of the linear source-drain voltage regime suggests that PANI devices exhibit markedly less contact resistance than gold devices.

[1]In collaboration with Kimberly Dickey, Kwangseok Lee, Joungeun Yoo, University of Texas at Austin; and John Anthony, University of Kentucky.