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Solvent-induced effects in polymer-wrapped s-SWNTs based fully printed field-effect transistors

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Despite the emergency of competing materials carbon nanotubes remain at the fore-front of the promising materials for organic electronics like field-effect transistors. Due to their properties, are among the most suitable structure to support the current advancements goals in flexible electronics. However, very few are the ways to make stable single walled carbon nanotubes (SWNT) dispersions for simple processing. To further push the adoption of this kind of devices in everyday life applications, high-throughput dispersion and fabrication methods must be adopted. In this work, we highlight how a simple process for chirality selection and dispersion of semiconducting SWNT may be used for the realization of all-printed Field Effect Transistors. Chirality selection is operated by polymer-wrapping of the s-SWNTs with poly [(9, 9-dioctylfluorenyl-2,7-diyl)-alt-co-(6,6'-{2,2'-bipyridine})] in common organic solvents, with a process optimized for the [6,5] chirality selection. After solution purification, wrapped nanotubes can be dispersed in those solvents suitable for printing. The printing process was performed in ambient air and at room temperature, and the SWNT ink was dispense using a nozzle with an orifice diameter of 60μm over pre-patterned source and drain electrodes. The devices exhibit ambipolarity, with a slight prevalence of the n-type behavior. For both electron and hole accumulations, at $V_{DS} = \pm 5V$ (linear regime) 10^6 on-off ratios can be observed, with mobilities (μ_{lin}) around 0,3 $cm_2V^{-1}s^{-1}$ for both carrier types. In saturation regime ($V_{DS} = \pm 60$ V) mobility values (μ_{sat}) up to 0.8 $cm^2V^{-1}s^{-1}$ for electrons and 0.65 $cm^2V^{-1}s^{-1}$ for holes are reached. The study also highlights the effects of different solvents on the carbon nanotube network formation and transistor performances with best results with those solvents that tend to form polymer pre-aggregates in the printed solution.

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