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Graphene as an electrode for nano organic transistors

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In this contribution we report the fabrication and electrical characterization of n-type organic thin film field effect transistors (OTFT) exploiting the use of graphene as Source and Drain electrodes for devices characterized by nano channel lengths. In particular, a bottom-contact/bottom-gate FET configuration has been employed as test pattern. CVD-grown graphene, transferred on the Si/SiO2 (300nm) substrate, has been used as Source and Drain electrode through electron-beam lithography nano-pattering, obtaining channel lengths (L) between 150 nm and 1um, for a fixed channel width (2um). A 25 nm thin film of a highly performing derivative of Perylene-3,4,9,10-tetracarboxylic acid diimide, also known as PDIF-CN2, is used as electron-transporting organic semiconductor, evaporated by means of Organic Molecular Beam Deposition (OMBD). The comparison between the electrical characterization of graphene based and gold based nano-devices with an analogous architecture clearly shows that the latter are affected by the well-know Drain-induced barrier lowering for ultra-short channel FET (L<400 nm). Such effect hinders the charge to be blocked by the energy barrier at the electrode/Channel interface also in depletion mode, resulting in high "off" currents and poor field-effect modulation of the channel currents. On the contrary, devices with graphene electrodes are characterized by remarkable On/Off ratios (as high as 800 even for ultra-short channel devices) that are slightly influenced by L and by the applied drain-source bias. Experimental result indicate that graphene, and in particular its morphological and electrical peculiarities, is an excellent candidate for nano miniaturization of organic field effect devices for practical applications.

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