Carbon nanocrystal-based organic thin-film transistors for nonvolatile memory nanodevices

Abstract

Organic semiconductor nonvolatile memory devices were successfully fabricated from organic thin-film transistors (OTFTs) embedded with nanocrystal carbon (nc-C) dots incorporating pentacene as an active layer. The nc-C dots were arranged in the channel region by a focused ion beam (FIB) technique using a precursor of low energy Ga+ ions and a carbon source. The formation and morphology of nc-C dot arrays were investigated using a scanning ion microscopy (SIM) and atomic force microscopy (AFM), respectively. The SIM and AFM images show that the nc-C dot array was successfully grown on the SiO 2 layer. The density of the two-dimensional nc-C dots was 5 x 10 9 cm-2. The current-voltage (I - V) characteristics at room temperature show that the fabricated OTFTs exhibit a memory effect upon the application of forward and reverse bias. Under the effect of gate bias, on and off states were induced and a threshold voltage shift (ΔVth = 0.23 V) was obtained. The charge carrier mobility (μ) of the OTFTs is similar in both on and off states. The memory effect was attributed to the nc-C dots in the pentacene-dielectric interface. © 2009 The Surface Science Society of Japan.