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Organic memory devices using the negative differential resistance effect R. OSTERBACKA, J.K. BARAL, H.S. MAJUMDAR, F. JANSSON, Center for Functional Materials and Department of Physics, Abo Akademi, Finland, A. LAIHO, R.H.A. RAS, J. RUOKOLAINEN, O. IKKALA, Department of Engineering Physics and Mathematics and Center for New Materials, Helsinki University of Technology, Finland, H. JIANG, E. KAUPPINEN, VTT Biotechnology, Finland
— Of all the organic memory devices reported so far the ones having the negative differential resistance (NDR) is the best in terms of yield, reproducibility and repeatability. We have observed two different kinds of NDR in nanoparticle based organic memory devices. One is the memory-NDR which follows the observation in SiO2 devices [Simmons et. al. *Proc. R Soc. Lond. Ser. A* **301**(1967)77]. Here the I-V characteristics trace different paths based on device history. The second type is the tunneling-NDR, where the I-V curves always trace the same path, irrespective of the history. This behavior is similar to the one observed in resonant tunnel diodes and multiple tunneling is the explanation. We will discuss these two phenomena in light of our experimental results in a polystyrene:fullerene nanocomposite system and present a physical model for the same. We have performed a multitude of optical and electrical experiments and clarified the influences of morphology on the complex and interesting device performance observed in this new class of organic electronic devices.

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