Crosspoint Memory Cells Based on Organic-Metal Structures

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High performance, non volatile, fast and cheap memory devices are required for today's technological applications. Flash memory has many of these advantages and but cannot reach the high endurance of hard disk, nor the low access times necessary to replace dynamic random access memory. There is therefore the need of promising candidates for flash-like memory elements. In this paper is presented a novel approach based on polymer-metal nanoparticle (NP) blends and layered structures of small organic molecules and granular metals. Elements are fabricated using a variety of conjugated and non-conjugated polymers. Small molecules Alq3 and NPB were used for the layered structure, while triarylamine (HTPA), polyvinylcarbazole (PVK), and poly-biphenyl (BPF9) where used in blended structure. Nanoparticles of variable size, distribution and concentration are synthesized. The organic/metal films were then sandwiched between metal contact and electrical measurements were performed. The DC electrical response of the memory element shows N-shaped current voltage (IV) characteristic and a hysteretic behavior at low voltages (L. D. Bozano et al., Appl. Phys. Lett. 2004, 84, 607). ON and OFF states can be set by proper choices of the voltage and the ON/OFF ratio is greater than 100. This behavior is reproducible in forward and reverse bias and works for all our choices of materials. Switching performance of the memory elements like ON/OFF current ratio, switching voltages and times, retention and cycling endurance, were determined by DC, pulse and AC electrical measurement. The resulting data are presented in the context of a model in which charge transport occurs both by conduction in the polymer host and tunneling between nanoparticles.