Abstract #2002, 224th ECS Meeting, © 2013 The Electrochemical Society

Flexible Conductive-bridging Random-access Memory Cell Fabricated with Stacked Polymer Electrolyte and Conductive Polymer

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ReRAM has been great of interest since it presented a simple sandwiched device structure of metal/insulator/metal, an easiness of cross-point array integration, and a three-dimensional stacking ability of memory-cells. Among various kinds of ReRAM cells, conductive-bridging random-access memory (CBRAM) cells has intensively paid an attention since they have a simple sandwich memory-cell structure of a bottom reactive metal, electrolyte, and top inert electrode and they showed a bipolar switching ReRAM characteristic. In particular, a CBRAM cell fabricated with the sandwiched structure of Cu/polymer solid electrolyte/Ru has been recently reported. In our study, we developed a flexible CBRAM cell fabricated with the sandwiched cross-bar device structure of top Ag electrode, polyethylene oxide layer (PEO), Poly(N-vinylcarbazole), (PVK), and bottom electrode, as shown in Fig.1. We investigated their nonvolatile memory characteristics, such as the bi-stable current-density verse voltage (*I-V*) curve, retention time, and program/erase cycles as a function of bending cycles.

The flexible CBRAM cell demonstrated a typical bipolar switching characteristic of a ReRAM, where V_{set} and V_{reset} were 0.9 and –2.6 V, respectively, as shown in Fig. 2. Both high resistances at positive and negative applied followed Pool-Frankel conduction while low resistance at positive and negative applied followed ohmic conduction. The asymmetrical *I-V* indicates the conical shape metallic ionic bridge is a symmetrical shape. The neck position of the conductive ionic bridge would be close to or less than the center of bridge since relative value of V_{reset} was large than V_{set}. Note that the CBRAM cell without the inserted PVK later between PEO and Pt bottom electrode did not show a bi-stable *I-V* for ReRAM. A retention time of 1.0 $\times$ 10^5 s was obtained only by sustaining a memory margin (I_{on}/I_{off}) of 1.67 $\times$ 10^5, which was sufficient for a commercial memory-cell, as shown in Fig. 3. Program and erase cycles of more than 10^3 were obtained by sustaining a memory margin (I_{on}/I_{off}) of 3.26 $\times$ 10^5, as shown in Fig. 4. In our presentation, we will review nonvolatile memory characteristics and their conduction mechanism in detail.

* This work was financially supported by the Industrial Strategic Technology Development Program (10039191, The Next Generation MLC PRAM, 3D ReRAM, Device, Materials and Micro Fabrication Technology Development) funded by the Ministry of Trade, Industry and Energy (MOTIE), Republic of Korea.

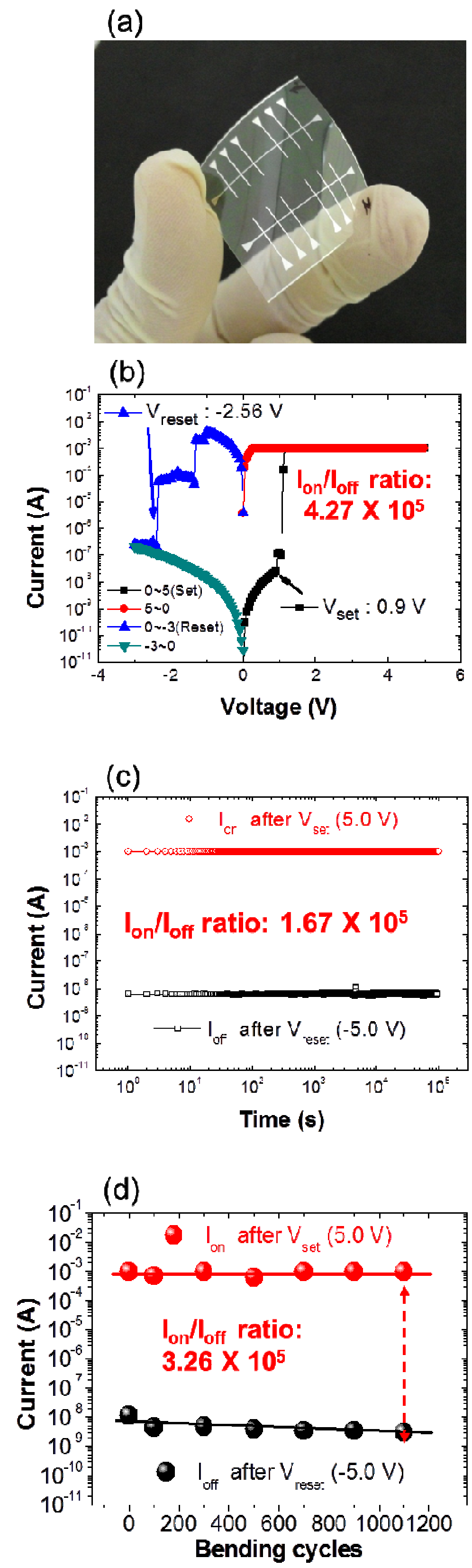

Fig 1. (a) Device picture, (b) I-V characteristic, (c) retention time, and (d) bending fatigue cycle

Reference

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