Organic resistive memory device composed of hyperbranched polystyrene and gold nanoparticles

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1. Introduction

Organic resistive memory (ORM) device is now attracting much attention due to the low-cost fabrication process.[1-3] Some materials have been proposed for the ORM. Nanoparticle/polymer composites are one of promising candidates because they can be fabricated into ORM by a simple solution process. Here we report that gold nanoparticles stabilized by a hyperbranched polystyrene (HPS) [1] performs ORM properties.

2. Experiment

The synthesis of HPS-stabilized Au nanoparticle (HPS-Au) has already been reported [1]. Fig.2 shows the molecular structure of HPS. In this system, the Au nanoparticles can be dispersed well to avoiding the aggregation of Au, and the mean diameter of Au is 2.8nm.

![Fig.1 Schematic representation of HPS synthesis](image)

On a glass substrate a bottom electrode with 80 nm aluminum was deposited in vacuum, and the organic active layer was formed by spin-coating from the solution containing HPS with dithiocarbamate endgroups and HPS-Au, followed by thermal treatment to remove solvent. A top Al electrode (90 nm) was deposited in vacuum. The measurements were performed at the temperature controlled stage in vacuum.

3. Results and Discussion

Fig. 2 shows the current density-voltage (J-V) characteristics of the OBD using HPS and HPSAu. Three lines represent Pristine state, ON state and OFF state. The current density decreased as the temperature rise. Therefore, it is suggested that the carrier transport mechanism which dominate the ON current is tunneling transport.

In addition, it is supposed that OFF current was decided by metallic conduction, which may have the relationship with the gold content in the composite films. Therefore, the gold particle can be aligned to form the conducting path in the insulating polymer matrix.

![Fig. 2 Current density-voltage characteristics of the device using HPS and HPSAu. Three lines represent Pristine state, ON state and OFF state.](image)
In the impedance measurement at OFF and ON state of the ORM (Fig. 4) only one semicircle was observed, indicating that the interface and the bulk were not distinguishable. These observations suggest that the switching between OFF and ON could be realized by the amputation and re-connection by the field-assisted self-organization of the gold nanoparticles.

**4. Conclusion**

In summary, we fabricated OB using hyperbranched polymer and gold nanoparticle. Since the ON current density is independent of device temperature, the tunneling transport supposed to be dominant in ON state. It is suggested that different carrier transport is dominant in an ON state and in an OFF state.

**References**

