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Resistive Random Access Memory Devices by different Organic Inorganic Hybrid Perovskites

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Abstract

Resistive memory devices, and in particular memories based on low-cost, solution-processable and chemically tunable organic materials, are promising alternatives explored by the industry. Such devices made from materials such as $CH_3NH_3PbBr_3$, $CH_3NH_3PbCl_3$ and $CH_3NH_3PbI_3$, exhibit high switching voltage and thereby require higher operational power. This also leads to resistive dissipation in the form of heat, leading to overheating of the devices and adversely affects their reliability. Addressing this demand, we report the organic– inorganic hybrid perovskite materials in Resistive memory devices with a remarkable appearance of switching effect which shows high reproducibility, fast switching, excellent endurance, stability and scalability. Perovskite employed memory devices were fabricated with a simple capacitor configuration (silicon-metal–dielectric) consisting of Si/Au/$CH_3NH_3PbX_3$ (X = I, Br, Cl) hybrid perovskite. The device exhibited remarkable unipolar and stable resistive switching behavior with small on–off voltage of < 2 V. In comparison to their inorganic counterparts, one noticeable advantage of organic–inorganic hybrid perovskites lies in their facile and low temperature processability. Here, we compare three different halide hybrid perovskite I/V in different temperature, variable voltage Raman spectra, SEM, PXRD, etc. These device can be used as resistive random access memory (RRAM), based on the resistive switching (RS) effect originated from a sudden resistance change, bistable state, and volatile properties. For device fabrication, first 100 nm Au was coated on RCA cleaned Si wafer by thermal evaporator. The perovskite solution (1M, DMSO solvent) was dispensed onto the Au-Si substrate and spin-coated at 3000 RPM for 30 s in air, followed by annealing at 80 °C for 10 min. In situ Raman measurements were taken to understand the mechanism behind switching behaviour of methyl ammonium lead halide perovskite devices. The variation of Raman peak signifying that it undergoes phase transition from orthorhombic to tetragonal to cubic in LRS to HRS.

Biography:

Dr. Pramiti Hui have expertise on Synthesis, Characterization, Self-Assembly, Optical Wave Guiding and Device fabrication. She studied Chemistry at the Banaras Hindu University, India and graduated as M. Sc in 2008. She then joined the research group of Prof. R. Chandrasekar at the University of Hyderabad (UoH), India with NET-CSIR Fellow and received her PhD degree in 2015. She finished her one year postdoctoral fellowship hosted by Prof. Gullermo Orellana at the Chemical Opto sensors Group and Laboratory, Madrid, Spain. Then she obtained the second postdoc position in IIT Bombay, India. She has published 7 research articles in peer review journals

Speaker Publications:

1. Hui, P., Khaja. Md. Arif, and Chandrasekar, R. "Syntheses, Optical and Intramolecular Magnetic Properties of Mono- and Di-Radicals Based on Nitronyl Nitroxide and Oxoverdazyl Groups Appended to 2,6-Bispyrazolylpyridine Core"Org. Biomol. Chem. 2012, 10, 2439-2446.
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