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Investigation of Resistive Switching in $CsPbCl_3$ / Cs_4PbCl_6 Core-Shell Nanocrystals Using Scanning Tunneling Spectroscopy: A Step Towards High Density Memory-based Applications

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Abstract : To deal with the increasing demands for the high-density non-volatile memory devices, we need nano-sites with efficient and stable charge storage capabilities. We prepared nanocrystals (NCs) of inorganic perovskite, $CsPbCl_3$ coated with Cs_4PbCl_6, by colloidal synthesis. Due to the type-I band alignment at the junction, this core-shell composite is expected to behave as a charge trapping site. Using Scanning Tunneling Spectroscopy (STS), we investigated voltage-controlled resistive switching in this heterostructure by tracking the change in its current-voltage (I-V) characteristics. By applying voltage pulse of appropriate magnitude on the NCs through this non-invasive method, different resistive states of this system were systematically accessed. For suitable pulse-magnitude, the response jumped to a branch with enhanced current indicating a high-resistance state (HRS) to low-resistance state (LRS) switching in the core-shell NCs. We could reverse this process by using a pulse of opposite polarity. These two distinct resistive states can be considered as two logic states, 0 and 1, which are accessible by varying voltage magnitude and polarity. STS being a local probe in space enabled us to capture this switching at individual NC site. Hence, we claim a bright prospect of these core-shell NCs made of inorganic halide perovskites in future high density memory application.

Keywords : Core-shell perovskite, $CsPbCl_3$-Cs_4PbCl_6, resistive switching, Scanning Tunneling Spectroscopy
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