Improving Resistive RAMs' Performance by Using Single Crystal MAPbBr3 Perovskite

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Memory devices are developing at a slow rate, hindering the computational industry’s growth. The hysteresis shown in perovskites has been utilized to create the two resistive states necessary for resistive RAMs (RRAMs), but the previous devices faced a problem when it came to stability. The purpose of this study was to introduce and study the effects of using single crystal MAPbBr3 perovskite in RRAMs when tested for: Ion/off, operation voltage, and retention time. The chemical stability of single crystals and the uniform ion migration in the active layers propose a stable RRAM that requires a low operation voltage. Therefore, a proof-of-concept memory device was fabricated thusly: The single crystal was grown by annealing MAPbBr3 in a crystal-growing template (< 5 μm) which was prepared by sandwiching ITO glass and glass substrate. Then, the glass substrate was removed and gold electrodes were introduced on the crystals. Lastly, the device was tested using a Keithley 4200 Semiconductor Parameter Analyzer. It showed a low operation voltage at 0.6 V, and an encouraging stability tested at 400 cycles and 10000 sec retention time. The I-V curves showed stability for more than 3 months which has not been attained prior to this research. These results confirm and support the conclusion that the chemical stability of single crystals leads to the stability of RRAMs and contributes to a lower operation voltage. This study can potentially be applied to make single crystal perovskite-based RRAMs which in turn can advance the memory industry in general.

Awards Won:

National Aeronautics and Space Administration: Top Award of $5,000

Fourth Award of $500