Green Memory Device Based on CdTe/CdSe Core-Shell Quantum Dots Incorporated Chitosan-PVP Polymer Blend

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Abstract:

Memory devices composed of organic materials have a profound effect on mitigating electronic waste. A memory device with a sandwich-type configuration, consisting of an active layer (AL) sandwiched between a bottom electrode (BE) and top electrode (TE), has been studied for its resistive switching property. The AL was composed of a composite material consisting of a combination of chitosan (CS) and polyvinylpyrrolidone (PVP) that was dispersed with CdTe/CdSe core-shell quantum dots. On the other hand, the TE was made up of silver (Ag), and the BE was provided by an indium-doped tin oxide (ITO) layer. The memory device was created using a polyethylene terephthalate (PET) substrate. Applying voltage between the Ag and ITO electrodes and measuring the current in the Ag/CS+PVP+CdTe/CdSE/ITO device revealed interesting findings. The device exhibited memory hysteresis, with a reasonable I_{ON}/I_{OFF} ratio of ≥ 10 and a low working voltage of ≥ 0.2 V. These observations suggest that the device functions as a memory device with minimal power consumption. Furthermore, the inclusion of CdTe/CdSe in the composite material was hypothesized to enhance the Schottky barrier's height at the electrode-active layer interface, effectively blocking electron entry into the active layer. As a result, conductive filaments were formed due to the diffusion of Ag+ ions into the active layer. Overall, our findings suggest the inclusion of CdTe/CdSe QDs may have the potential to improve the memory and switching capabilities of the CS/PVP blend-based resistive switching memory may be utilized.

Keywords:

Chitosan, PVP, CdTe/CdSe, ReRAM, green memory.