Engineering Optoelectronic Properties for the SiO_x-based ReRAM

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Abstract - Non-volatile memory devices such as redox-based resistive random-access memory (ReRAM) offer promising capabilities for memory storage and computation beyond the von Neumann architecture. Recently, there has been great interest in integrating optoelectronic properties within a ReRAM device. Resistance switching behavior through light stimuli could offer better controllability, lower electrical crosstalk, and introduce new functionality. Silicon oxide, SiO_x, is a favorable dielectric for ReRAM, due to its high stability, high reliability, and CMOS compatibility. However, SiO_x is transparent across the visible and near infrared regions of the optical spectrum. In this work, we present a method to engineer optoelectronic interaction in ReRAM devices using SiO_x as the resistance switching layer. We further report device performance for the electroforming and the set/reset behavior, both in the dark and under illumination at varying optical wavelengths. Lastly, we postulate the physical mechanism behind the optical response of our ReRAM devices. The addition of optoelectronic interaction in SiOx-based ReRAM will offer new possibilities for emerging applications such as reservoir computing, edge computing, and neuromorphic computing.