Mesoporous SiO_2 thin films for cost-effective memory applications

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Conductive Bridge Random Access Memories (CBRAM) are interesting candidates for printed memory devices on flexible substrate, thanks to their simple architecture (metal-insulator-metal or MIM structure). Mesoporous SiO_2 can be advantageously used as solid electrolyte for CBRAMs, as its porous structures can be used to regulate the ionic dynamics and the growth of conductive filaments. Besides, SiO_2-based CBRAM cells show good performances such as low switch voltages and high ratios between the low resistive and the high resistive states. However, most deposition processes for this oxide are based on microelectronics techniques such as sputtering or atomic layer deposition, implying high equipment costs, vacuum and complex manufacturing processes and limited volume capacities as drawbacks.

In this study, CBRAMs with an $Ag/SiO_2/Pt$ structure were fabricated using a heterogeneous process combining printing (inkjet) and sol-gel deposition techniques. A preliminary study was carried out to produce tuneable mesoporous SiO_2 thin films, varying both thickness and porosity of the silica layer. In this way, the impact of these parameters (porosity and thickness of silica) on the memory cell performances can been studied.

The investigated memory cells demonstrate non-volatile behaviour, with low switching voltages, a significant ratio between the low and high resistance states, and reliable endurance over 10^3 cycles. These results provide an opportunity to manufacture cost-effective crossbar memory arrays on large-area substrates through the integration of sol-gel and inkjet-printing techniques.