Poly-4-vinylphenol and Poly(melamine-co-formaldehyde) - Based Atomic Switching Device

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Atomic switches have recently attracted attention asnext-generation nanoswitching devices. It have a simple metal+insulator+metal(MIM) structure and are easily controlled by the formation/decomposition of aconduction filament through the diffusion of active metal ions. Because ofunique switching mechanism based on redox-based electrochemical reactions,these atomic switching devices indicate a low operating voltage (<0.05 V), ahigh on/off-current ratio ($>10^6$), an exceptionally highretention time (>10 years), and an excellent cyclic endurance ($>10^6$).Because the MIM structure of atomic switches typically consists of activemetals (i.e., Cu and Ag), high-k dielectrics (i.e., HfO_2, Al_2O_3, and Ta_2O_5),and inactive metals (Pt, W, and TiN), these switching devices can be alsoformed at low temperatures. Recently, flexible polymer materials are startingto be considered as solid electrolytes for atomic switching devices for futureelectronic applications.

In this study, we demonstrate a high-performance solidpolymer electrolyte (SPE) atomic switching device with low SET/RESET voltages(0.25 and +0.5V, respectively), high on/off-current ratio (10^5), excellent cyclic endurance($>10^3$),and long retention time ($>10^4$ s), wherepoly-4-vinylphenol (PVP)/poly(melamine-co-formaldehyde) (PMF) is used as an SPElayer. This research successfully presents the feasibility of PVP/PMF atomicswitches for flexible integrated circuits for next-generation electronicapplications