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Improvement of resistance switching behavior by localizing filament with Si injection WO_X switching layer

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Metal-insulator-metal (MIM) structures with transition metal oxide (TMO) are typically used to implement resistance random access memory (RRAM) device. In this paper, we have demonstrated the RRAM property with the two structures, TiN/WO_X/Pt and TiN/$WSiO_X$/Pt. A constant voltage forming method is used to induce repeatable bipolar resistance switching behavior. Comparing with the TiN/WO_X/Pt structure, the TiN/$WSiO_X$/Pt device exhibits excellent characteristic with good endurance ratio of more than 10^5, long retention time of 10^4 s in 125℃, and more stable in resistance switching state. Furthermore, the switching mechanism is investigated by current-voltage (IV) curve fitting and material analysis. From the experimental results, we supposed that the conductive path of the TiN/WO_X/Pt RRAM device is disordered due to its random filament formation in the switching layer. On the other hand, the switching behavior in the TiN/$WSiO_X$/Pt device is regarded as point electric field by localizing filament between the interface of top electrode and insulator. The TiN/$WSiO_X$/Pt device presents a highly stable and excellent memory feature for developing next generation nonvolatile memories.