Hexagonal Boron Nitride Memristor Based on a Nanogap Self-Formed by Silicidation

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Recently, memristors composed of 2D materials have attracted significant attention as non-volatile memory devices. They can act as a switch with high/low-resistance states and as a memory for preserving the resistance state without energy supply. The hexagonal boron nitride (h-BN) memristor is considered as a potential candidate for radio-frequency application due to the advantages of low insertion loss, high isolation, high cutoff frequency and energy efficiency. In traditional memristor structures, metallic materials (or graphene, as reported in a few articles) are chosen as electrodes. However, most noble metals are limited in CMOS process due to cost, compatibility or contamination issues. In this work, we prepared a lateral h-BN memristor with silicide electrodes. In the fabrication, a nanogap is self-formed between two silicide electrodes laid on the SiO_2 substrate via the stoichiometric solid-state reaction of Pt and Si during the silicidation. Next, a CVD-grown h-BN sheet is transferred on the nanogap by a wet-transfer method. The nanogap formation is simple, achieved without using any lithography tools and the silicide electrodes are compatible with CMOS technology. For comparison, we also prepared a reference memristor with no h-BN sheet. The resistive switching behavior (i.e. hysteresis loop current-voltage characteristics) was not observed in the reference memristor under the same measurement conditions. The endurance of the h-BN memristor is larger than 30 cycles. Moreover, the conductance ratio of h-BN memristor is up to 10^4 between on and off states. Our results indicate that h-BN sheet plays an important role in the switching behavior. The real physical mechanism behind the resistive switching behavior of h-BN is still under investigation and further experiments, such as retention time, temperature dependence, noise and S-parameters measurements for RF performance, are on-going.