Due to digital cameras, smart phones and consumer electronics products are used widely, non-volatile memory (NVM) for use in the next few years will grow substantially. With increasing challenges of scaling conventional floating gate flash memory technology, alternative non-volatile memory technologies are under investigating, such as resistance random access memory (RRAM). RRAM has attracted extensive attention due to it has a lot of prominent performances. Therefore, it has promising potential in the next-generation non-volatile memory. However, the physical origin of this switching phenomenon is not yet clearly. Therefore, elucidation of mechanism is very important in the development of RRAM.

In this thesis, we investigate the resistance switching characteristics of Cr2O3-based RRAM with different electrodes, such as Pt/Cr2O3/Pt, Pt/Cr2O3/TiN, Pt/Ti/Cr2O3/TiN and Ti/Cr2O3/Pt structures. In our results, we directly observed the oxygen migration and realized the RESET mechanism. Furthermore, we find that using TiN as oxygen reservoir is more stable than Ti. Subsequently, we discuss the conduction mechanism of Pt/Cr2O3/TiN structure under different bias region by current fitting. It is very helpful to realize the physical origin of the switching phenomenon. Moreover, we investigate the multi-level feasibility of Pt/Cr2O3/TiN structure. It is reported that using On-states as multi-level is suitable than Off-states. Furthermore, Pt/Cr2O3/TiN structure exhibits prominent resistive switching behavior. Both low resistance (ON state) and high resistance (OFF state) are stable and reproducible during a successive resistive switching by using a DC voltage sweeping. The resistance ratio of ON and OFF state is over 100 times. The retention
properties of both states are also very stable. Finally, we conclude that Pt/Cr2O3/TiN has promising potential in the next-generation non-volatile memory.