HfZrO WRITE-ONCE-READ-MANY MEMORY FABRICATED USING A SIMPLIFIED AND LOW-COST SOL-GEL PROCESS

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Abstract - This study demonstrates write-once-read-many (WORM)memory characteristics of a Ti/HfZrO/n^+-Si device. TheHfZrO thin film, which was synthesized using a sol-gel process, was spin-coated on a heavily doped silicon (n^+-Si) substrate as a switching layer.Then, the sample was annealed in a furnace at 700 °C for 1 hour under flowing O_2.The Ti top electrode was deposited using thermal evaporation to obtain aTi/HfZrO/n^+-Si WORM memory. Fig. 1 shows WORMcharacteristics of the memory.When a positive bias is applied to the Ti top electrode of the device, oxygen ions are attracted to the electrode because of the external applied electric field. Numerous oxygen vacancies are created in the HfZrO layer.Eventually,the oxygen vacancies connect to each other and form a conductive path in the HfZrO film. A sudden current increase is obtained and the memory switches from a high-resistance state (HRS) to a low-resistance state (LRS). The LRS/HRS current ratio is 10^7, and the writing voltage is about 4 V.The conductive path cannot be ruptured even thoughthe applied voltage is reversed. This is because the conductive path is formed by plentiful oxygen vacancies and it is difficult to be dissociated bythe following voltage sweeps. We also tested the data retention capabilities and read disturb immunities of theHfZrO WORM memory at 25 and 85 °C. As shown in Fig. 2 (a),the HRS and LRS show no degradation during 10^4 s tests at 25 and 85 ℃, and anLRS/HRS current ratioof 10^7 is clearly observed. Fig. 2(b) reveals that the HRS and LRS can still remain stableeven under a constant voltage stress.The LRS/HRS current ratio shows no degradation, and the predicteddevice lifetime is more than 10 years.The proposed low-cost sol-gel HfZrO WORM memory will help enhance the efficiency of data storage systems and ensure the reliability of secure informationarchiving.

Keywords - write-once-read-many (WORM),HfZrO,oxygen vacancy,resistive memory

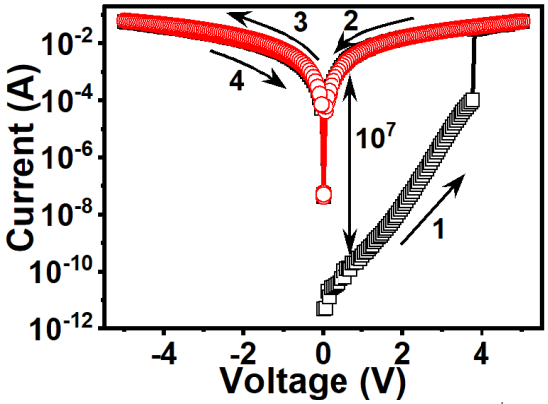


Fig. 1 Write-once-read-many characteristics of the Ti/HfZrO/n^+-Si memory.

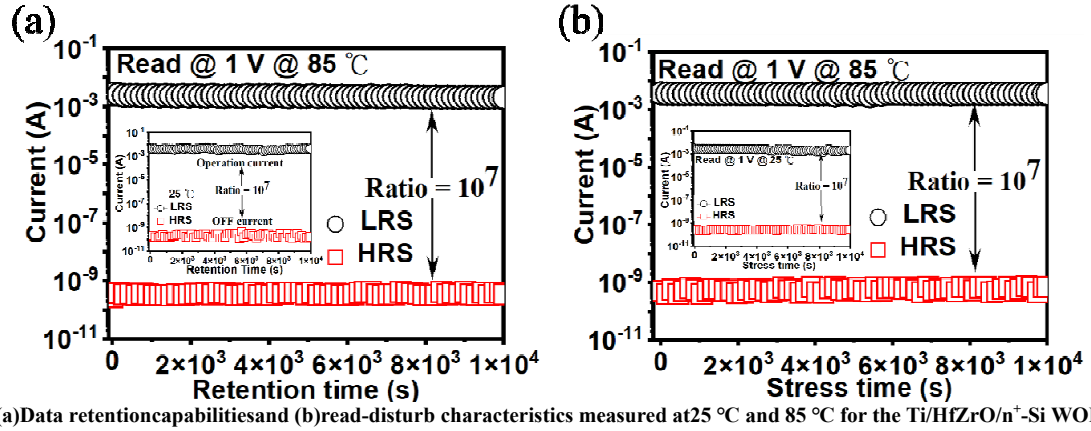


Fig. 2(a)Data retentioncapabilitiesand (b)read-disturb characteristics measured at25 ℃ and 85 ℃ for the Ti/HfZrO/n^+-Si WORM memory.

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