Friday, 28-Jan-2022

Dear Fei Qin,

Your abstract (ID: 3724512) entitled:

"Influence of Oxygen Vacancy and Top Electrode on Switching Behavior of InGaZnO Based Resistive Random Access Memory"

has been submitted to the 64th Electronic Materials Conference. Please print and retain a copy of this message. Notification of your abstract status (Accepted or Not Accepted) will be sent to you in mid-March.

Your abstract submission is below:

Control ID # (3724512)
Title: "Influence of Oxygen Vacancy and Top Electrode on Switching Behavior of InGaZnO Based Resistive Random Access Memory"
Abstract Body: Abstract Body
Biomimetic synaptic processes, which are imitated by functional memory devices in the computer industry, are a key focus of artificial intelligence (AI) research. It is critical to develop a memory technology that is compatible with Brain-Inspired Computing in order to eliminate the von Neumann bottleneck that restricts the efficiency of traditional computer designs. Due to restrictions such as high operation voltage, poor retention capacity, and high power consumption, silicon-based flash memory, which presently dominates the data storage devices market, is having difficulty meeting the requirements of future data storage device development. The developing resistive random-access memory (RRAM) has sparked intense investigation because of its simple two-terminal structure: two electrodes and a switching layer. RRAM has a resistive switching phenomenon which is a cycling behavior between the high resistance state and the low resistance state. This developing device type is projected to outperform traditional memory devices. Indium gallium zinc oxide (IGZO) has attracted great attention for the RRAM switching layer because of its high transparency and high atomic diffusion property of oxygen atoms. More importantly, by controlling the oxygen ratio in the sputter gas, its electrical properties can be easily tuned. The IGZO has been applied to the thin-film transistor (TFT), thus, it is very promising to integrate RRAM with TFT.

In this work, we proposed IGZO-based RRAMs. ITO was chosen as the bottom electrode towards achieving a fully transparent memristor. And for the IGZO switching layer, we varied the O_2/Ar ratio during the deposition to modify the oxygen vacancy of IGZO. Through the XPS measurement, we confirmed that the higher O_2/Ar ratio can lower the oxygen vacancy concentration. We also chose ITO as the top electrode, for the comparison, two active metals copper and silver were tested for the top electrode materials. For our IGZO layer, the best ratio of O_2/Ar is the middle value. And copper top electrode device has the most stable cycling switching and the silver one is perfect for large memory window, however, it encounters a stability issue. The optical transmission examination was performed using a UV-Vis spectrometer, and the average transmittance of the complete devices in the visible-light wavelength range was greater than 90%, indicating good transparency. 50nm, 100nm, and 150nm RS layers of IGZO RRAM were produced to explore the thickness dependency on the characteristics of the RS layer. Also, because the oxygen vacancy concentration influences the RS and RRAM performance, the oxygen partial pressure during IGZO sputtering was modified to maximize the property. Electrode selection is critical and can have a significant influence on the device's overall performance. As a result, Cu TE was chosen for our second type of device because Cu ion diffusion

can aid in the development of conductive filaments (CF). Finally, between the TE and RS layers, a 5 nm SiO2 barrier layer was used to limit Cu penetration into the RS layer. Simultaneously, this SiO2 inserting layer can offer extra interfacial series resistance in the device, lowering the off current and, as a result, improving the on/off ratio and overall performance.

In conclusion, transparent IGZO-based RRAMs have been created. The thickness of the RS layer and the sputtering conditions of the RS layer were modified to tailor the property of the RS layer. A series of TE materials and a barrier layer were incorporated into an IGZO-based RRAM and the performance was evaluated in order to design the TE material's diffusion capabilities to the RS layer and the BE. Our positive findings show that IGZO is a potential material for RRAM applications and overcoming the existing memory technology limitation.

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If you have any questions, please feel free to contact me.

Sincerely,

MRS Admin
Senior Technical Program Administrator
Materials Research Society
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