RESISTIVE SWITCHING IN MEMRISTOR STRUCTURES WITH MULTILAYER DIELECTRICS

Joonas Merisalu[1] (presenting author), Jaan Aarik[1], Aile Tamm[1], Kaupo Kukli[1]

[1]*Institute of Physics, University of Tartu, W.Ostwaldi 1, 50411 Tartu, Estonia*
e-mail of presenting author: joonas.merisalu@ut.ee

Resistive switching (RS) is a phenomenon, which can be observed in two-terminal nanoelectronic devices. The electrical resistance of these devices can be changed, i.e. switched by electrical stimuli between at least two non-volatile resistance states. Within last decade the interest in this phenomenon has exponentially increased due to the demand for new-generation computer memories. Hence, the RS devices are also called resistive switching random access memories RRAMs [1].

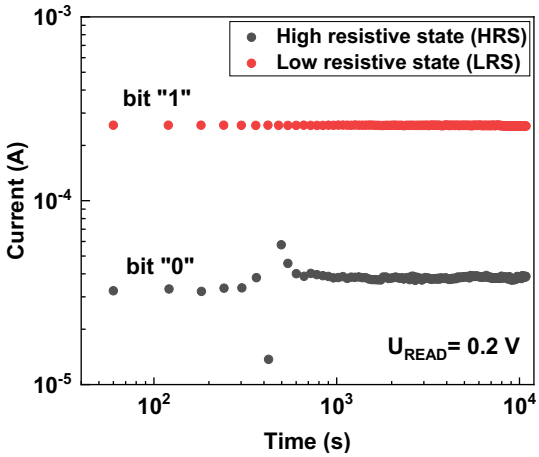

Fig.1 ZrO_2-$Zr_xAl_yO_z$ mediums' RS state retention characteristic measured at 80 °C .

This research was focused on RS in dielectrics composed of different combinations of metal oxides (TiO_2, Al_2O_3, ZrO_2, HfO_2). The work was based on electrical measurements, which, although being indirect method, is until today the most direct method to study resistive switching properties of RS media. The investigation of artificially structured RS media (TiO_2 - $Ti_xAl_{1-x}O_y$ [2], ZrO_2:Al_2O_3, ZrO_2-$Zr_xAl_yO_z$ [3], etc.) demonstrated that atomic layer deposition enables modifying RS properties like endurance, LRS/HRS ratio (memory window), and memory state retention time (Fig 1). Applying novel ALD sequence enabled controlled fine tuning of the LRS/HRS ratio. Depositing asymmetric buffer layer changed the RS direction and extended switching endurance. Employing graphene extended LRS/HRS ratio and modified RS state retention.

References

1. A. R. Patil, T. D. Dongale, R. K. Kamat, and K. Y. Rajpure, Binary Metal Oxide-Based Resistive Switching Memory Devices: A Status Review, 2023, *Materials Today Communications* 34, 105356.
2. J. Merisalu et al., Engineering of Atomic Layer Deposition Process for Titanium-Aluminum-Oxide Based Resistively Switching Medium, 2022, *Materials Science and Engineering: B* 282, 115797.
3. J. Merisalu et al., Structure and Electrical Properties of Zirconium-Aluminum-Oxide Films Engineered by Atomic Layer Deposition, 2022, *Coatings* 12, 431.

Euroopa Liit
Euroopa
Regionaalarengu Fond

Eesti
tuleviku heaks