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$Ce_{0.8}Gd_{0.2}O_{1.9}/VO_2$ memristive devices

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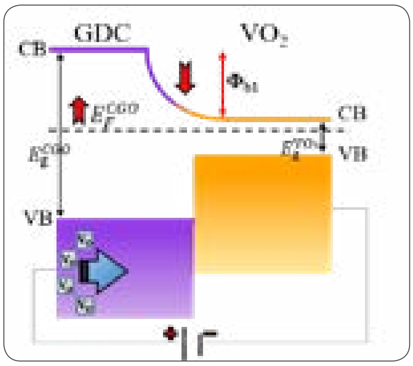
Electrochemical resistive switches operating on ionic carriers, sometimes named memristors, may revolutionize the future electronics as the next generation building blocks of non-volatile memory and neuromorphic computing replacing electronically operated classic transistor structures. Despite an extensive research performed on solid oxide materials, the technology is still immature. Therefore, the exploration in the direction of understanding the mechanisms and adaptation of novel materials systems is ongoing. In this presentation, we show a study of memristive properties of $Ce_{0.8}Gd_{0.2}O_{1.9}/VO_2$ thin film system (Gd-doped ceria (GDC), and V^{4+} vanadia). Ceria is a well-studied ionic conductor that tolerates high percentage of mobile oxygen vacancies. Vanadia, as VO_2 is famous for its metal-insulator transition, an ability to switch the resistance by several orders of magnitude by change of temperature, electromagnetic fields or mechanical strain beyond a sufficient transition level. Furthermore, ceria is a wide bandgap (~3 eV) and vanadia is a narrow bandgap n-type semiconductor (0.7 eV). Combination of these materials in one device seems incompatible for the conventional electronic materials strategy due to the dissimilar electric/dielectric properties. We show that integrating both oxides in the double layer device yields to synergetic memristive results, which are uncharacteristic neither for GDC nor for VO_2 as oxide constituents. It was experimentally found that the conduction and the resistive switching are governed by the mass transport kinetics, which is a function of the applied voltage, the electric field and the voltage application rate. We suppose that the field-induced transport of oxygen vacancies to and from the ceria-vanadia interface modifies the electrically variable energy barrier, which tunability is responsible for the enhanced memristance effect.



Recent Publications:

1. V Venckute, S Kazlauskas, E Kazakevičius, A Kežionis, R Korobko and T Šalkus (2018) High frequency impedance spectroscopy study on Gd-doped CeO_2 thin films. Ionics 24(4):1153-9.
2. R Schmitt, J Spring, R Korobko and J L M Rupp (2017) Design of oxygen vacancy configuration for memristive systems. ACS Nano 11:8881-8891.
3. N Yavo, A D Smith, O Yeheskel, S Cohen, R Korobko, E Wachtel, P R Slater and I Lubomirsky (2016) Large nonclassical electrostriction in (Y, Nb)-stabilized δ-Bi_2O_3. Adv. Funct. Mater. 26:1138-1142.
4. G Lazovski, O Kraynis, R Korobko, E Wachtel and I Lubomirsky (2015) Optical investigation of oxygen diffusion in thin films of Gd-doped ceria. Solid State Ion 227:30-37.
5. R Korobko, A Lerner, Y Li, E Wachtel, A I Frenkel and I Lubomirsky (2015) *In-situ* extended x-ray absorption fine structure study of electrostriction in Gd doped ceria. Appl. Phys. Lett. 106(4):042904.

Biography

Roman Korobko received his BA in Chemistry and BSc in Materials Engineering in Technion – Israel Institute of Technology in 2003. He continued his studies in the Faculty of Chemistry of the Weizmann Institute of Science. He earned an MSc in the theme of Molecular Electronics in 2009 and PhD on controlling the elastic properties of ceramics with an external electric field in 2014. Until 2017 he was conducting a Postdoctoral Research in ETH Zurich in the field of Memristive Materials. Now he holds the position of Senior Intern in Inharmonicity of Functional Materials group at Weizmann Institute of Science. His research interests include the elastic, electronic, electromechanical and memristive properties of dielectrics, focusing on solid oxide ionic conductors. He was a recipient of the 2012 Acta student award and E-MRS 2013 graduate student award

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