Acknowledgements

This study was supported by grant program AP05133499 of Committee of Science, Ministry of Education and Science of RK

Nonvolatile resistance switching in monolayer transition metal dichalcogenides: an explanation

F. Sava, A. Velea, C. O. Mihai, A. T. Buruiana

National Institute of Materials Physics, Atomistilor 405A, 077125, Magurele Romania

Corresponding author: fsava@infim.ro

Recently, Ge et. al. [1] showed that in atomic sheets of transition metal (from the group VI B) dichalcogenides (TMD) (Fig. 1) (MoS_2, $MoSe_2$, WS_2 and WSe_2) nonvolatile resistance switching occurs.

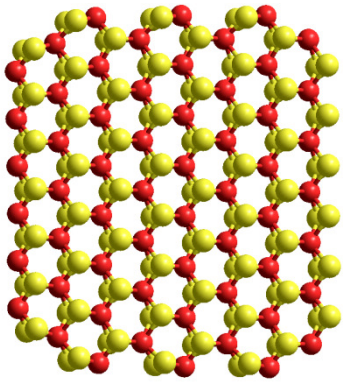

Fig. 1. An oblique view from above of the TMD structure three-dimensional model, with the chalcogen atoms in yellow and the transition metal atoms from the group VI B in red.

In order to understand this behaviour of mono-layer TMD, at these very intense electric fields ($E = 1.43*10^9$ V/m), we advance the hypothesis (and structural models) that the nonvolatile resistance switching might occur by two successive structural transformations due to local coordination changes of the transition metal and the chalcogen atoms.

Acknowledgements

The authors kindly acknowledge the financial support of the Romanian Ministry of Research and Innovation in the framework of the Core Program 5N/2018 - Act ad.1/2018.

References

[1] R. Ge, X. Wu, M. Kim, J. Shi, S. Sonde, L. Tao, Y. Zhang, J. C. Lee, and D. Akinwande, Nano Lett. 18(1), 434–441 (2018). DOI: 10.1021/acs.nanolett.7b04342.

Chalcogenide materials screening for Ovonic Threshold Switching

C. Mihai*, A. Velea

National Institute of Materials Physics, Atomistilor 405A, RO-077125 Magurele, Ilfov, Romania

Corresponding author: claudia.mihai@infim.ro

The world need for data storage and processing is increasing at a rapid pace. A response to this societal demand could come from ovonic threshold switches based on chalcogenide materials, which are leading candidates for emerging resistive memory technologies and neuro-inspired computing technologies.

Ovonic threshold switching (OTS) is a volatile non-linear electrical characteristic observed in some amorphous chalcogenide materials. A material switches from a high resistive state (HRS) to a low resistive state (LRS) when applying a voltage that exceeds its threshold voltage. It remains in the LRS state as long as a minimum holding voltage is maintained, otherwise it switches in HRS.

Here [1], we have developed a chalcogenide materials map to screen for new Te-based OTS materials. The main properties used for developing the map were the average number of p-electrons and the bond-orbital coordinates namely hybridization and ionicity. Also, a glass transition temperature (T_g) model was developed and employed to filter potential thermally stable compositions.

Promising candidates for thermally stable ternary OTS materials are predicted. We observe that there is a trade-off to be made between thermal stability and good OTS behavior when selecting a material depending on the targeted application.

Acknowledgements

The authors kindly acknowledge the financial support of the Romanian Ministry of Research and Innovation in the framework of the TE 62/2018 (PN-III-P1-1.1-TE-2016-1997) project.

References

[1] A. Velea, K. Opsomer, W. Devulder, J. Dumortier, J. Fan, C. Detavernier, M. Jurczak, B. Govoreanu, Sci. Rep. 7, 8103 (2017)., DOI: 10.1038/s41598-017-08251-z