Effect of the electron beam exposure on the electrical properties of the nanodevices based on Transition Metal Dichalcogenides.

Michał Świniarski [1], Karolina Czerniak-Łosiewicz [1], Jakub Sitek [1], Arkadiusz P. Gertych [1], Małgorzata Giza [1], Mariusz Zdrojek [1]

[1]*Faculty of Physics, Warsaw University of Technology, Koszykowa 75, 00-662 Warsaw, Poland*

The modern world of electronics is ruled by progressive miniaturization, which is one of the ways to improve the performance of computing capabilities. This is usually realized by lowering the size of the basic logic element, which is the Field-Effect Transistor (FET). The possible way to reduce the size of the transistor is to reduce its active channel dimension. The thinnest possible channel material are two-dimensional semiconductors, for example, MoS_2 and WS_2 from the Transition Metal Dichalcogenides (TMDs) family. The progressive miniaturization also requires highly precise production and inspection techniques based on the electron beam. The single or few layers of the TMDs tends to be sensitive to the electron beam exposure [1], [2], which also opens a new possibility in changing its properties, especially for our needs. The *material on-demand* approach is now enhanced with another technique, which allows precise trim of the devices [3]. The next step is to understand the physics of this process, and next use it to control the electrical properties of the new nanodevices.

In this work, we would like to present how the electron beam influences the electronic properties of the MoS_2 and WS_2 single and few layers. For this purpose, we fabricated the nanodevices on the TMDs in the FET architecture to control how the electrical properties are changing with the progressive electron beam exposure (dose). We focused on the two aspects: (a) How the performance of the devices changed with the electron dose, such as mobility, threshold voltage, sub-threshold swing. (b) The *in-situ* change of the source-drain current of the TMDs devices.

The presented study shows how the electron beam could be used to control the performance of the nanodevices based on new low-dimensional TMDs.

[1]W. Shi *et.al.*, Nature Electronics. **3**, 99-105 (2020).
[2] M.-Y. Lu *et.al.*, Phys. Chem. Chem. Phys.. 20, 9038 (2018).
[3] S.-J. Lee *et.al.*, Nature Electronics. **3**, 77-78 (2020).