

Project 4.7 MBE growth and characterization of oxide heterostructures for photovoltaic applications (experimental)

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Unit: ON.4.4

www: <http://www.ifpan.edu.pl/sdvs/pl/on4.4.html>

Background:

The last few decades have brought a true electronic revolution of enormous significance to our everyday lives. Recently, transparent conducting oxide (TCO) thin films, such as indium tin oxide and cadmium oxide have attracted significant attention because of their simultaneously high transparency in the visible spectrum and low resistivity. In the TCO family, II-VI oxides ternary alloys have attracted the considerable interest of the scientific community due to the possibility of modulating their interesting optoelectronic properties. In this proposal, we would like to explore and broadly characterize new highly prospective and so far poorly tested quasi ternary oxides CdO/MgO and CdO/ZnO. We plan an unusual and innovative approach to the growth of these mixed crystals. We would like to apply and explore alternate growth of MgO, CdO and ZnO thin layers (quasi ternary alloys). Applying an advanced growth method, which is Molecular Beam Epitaxy (MBE), will open up a possibility of growing layers and short-period superlattices (SL), i.e. alternating growth of two or more thin layers of different materials. Basic research on the physical properties of these oxides, by combining the use of many innovative experimental techniques, will allow to significantly broaden knowledge on these perspective materials, which further will open the new avenues for their future application.

New approaches to "ultra-high efficiency" solar cells include devices such as multiple quantum well (MQW) and superlattice systems. These configurations make it possible to improve the spectral response of the cell in the energy region below the absorbing edge of the barrier material.

Basic research and the results of advanced structural, optical and electrical characterization are crucial for bringing out the potential of layers and structures based on CdO/MgO, CdO/ZnO quasi-ternary alloys. Extensively focused research of these new materials is important for the development of semiconductor physics, especially because our current knowledge about these ternary alloys is very limited.

Aim:

In this proposal extensive investigation of electro-optical parameters of new highly perspective II-VI quasi-alloys - superlattices (SLs) based on CdO, ZnO and MgO are planned.

Requirements:

- knowledge about basic optical, structural and electrical characterization of the semiconductors,
- knowledge of material physics, solid state physics,
- ability to work with the Origin program,
- Master's degree in physics (or an equivalent that qualifies one for PhD studies in physics in the country of issue; Master's degree obtained not earlier than in 2018).

Funding:

Scholarship: grant funding of 5000 PLN per month-for 4 years, before subtracting obligatory employer and employee social security contributions (~15%).

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