Project 6.1. Quantum structures based on wide band gap semiconductors for application I UV optoelectronics

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Background:

Recently, great efforts have been made to develop far ultraviolet (UV) optoelectronic devices suitable for water purification, disinfection and other medical applications. Among the nitride compounds, hexagonal BN (h-BN) is a promising candidate. It is a wide-gap semiconductor (~ 6 eV) with very high thermal and chemical stability. The h-BN photoluminescence intensity was found to be almost 100 times greater than that of commercial AlN layers.

At the same time, there is a significant increase in the importance of oxide semiconductors. Due to the low cost of ZnO layers, their high crystal quality and resistance to radiation, the oxides can compete with GaN-based materials. Moreover, ZnO-based materials have important potential industrial and medical applications due to their biocompatibility and biodegradability properties. In the far UV range, ZnMgO-based quantum structures crystallizing in rocksalt (RS) structure with an energy gap of 4.2-7.8 eV are promising candidates.

In light emitting diodes or lasers, light emission is tuned by changing the chemical composition of the quantum structure and / or the thickness of its layers, and thus by changing the value of the energy gap. W projekcie przebadane zostaną metodami ab-initio struktury oparte na bazie h-BN i RS-ZnMgO, z uwzględnieniem wpływu wszystkich mikroskopowych mechanizmów na przerwy energetyczne.

Aim:

The aim of the project is to create a theoretical basis for the applications of wide-gap quantum structures in far UV optoelectronics. Quantum structures based on h-BN and RS-ZnMgO will be examined. Final indications for extending the range of wavelengths emitted in optoelectronic devices towards far UV will be formulated on the basis of theoretical results compared to experiments conducted at the Institute of Physics PAS and the Institute of Physics of the University of Warsaw.

Requirements:

- Master degree in physics or a related field and predispositions to work in theoretical or computer physics.