

Project 4.3 Ternary CdMgO layers doped with Eu (experimental)

Supervisors: Ewa Przeździecka

Institute: IFPAN

Unit: ON4.4

www: <https://www.ifpan.edu.pl/instytut-fizyki-pan/oddzialy-naukowe/oddzial-fizyki-i-technologii-nanostruktur-polprzewodnikow-szerokoprzerwowych/on4-4-zespol-mikroskopii-i-spektroskopii-elektronowej.html>

Background:

A key feature to undertake intensive study of CdMgO alloys is bandgap tunability across the spectral range from deep ultraviolet (UV C) to yellow color. The luminescence efficiency of rare earth (RE) elements e.g.: europium (Eu) is enhanced when embedded inside a wide-band gap host matrix. The excitation and emission properties of RE elements are well-defined in their host matrices consequent to the shielding of inner 4f-electrons by the outer 5s² and 5p⁶ electrons like in RE-free ions. In case of europium doping we expect strong red emission and intensity of this emission will depend on the energy gap of the matrix as well as its quality. Additionally in short period superlattices we can create series of quantum wells and precisely locate Eu atoms in the wells or barriers due to very good control of epitaxial process.

In our laboratory, thanks to the use of advanced growth technique and extensive research, we can investigate new quantum structures precisely doped into the planned materials.

Aim:

The aim of the proposed project is to understand the effect of Eu doping on the physical properties of CdMgO and CdO/MgO superlattice structures obtained by molecular beam epitaxy (MBE) method.

The planned research concerns in situ MBE growth of epitaxial structures doped with Eu ions. The samples will be examined by combining several experimental techniques, e.g.: photoluminescence, cathodoluminescence, transmittance, reflectance and microscopic techniques such as atomic force microscopy, scanning electron microscopy and others. The crystallographic quality of the layer will be determined by X-ray diffraction techniques.

The work will provide experimental data and analyzes relevant to understanding the position of Eu in the matrix and how the energy transfer process in CdMgO alloys and CdO/MgO short-period quasi-alloy superlattices depends on the manipulation of the energy gap.

Requirements:

- Highly motivated student, preferably with physics educational background and interest are desired,
- He/She should hold a M.Sc. degree in Physics or Materials Sciences or in a related research field (or an equivalent that qualifies one for PhD studies in physics in the country of issue),
- She/He should have strong interest in experimental science, but also to some extent in theoretical work, some experience with optical measurement techniques,
- good skills in Origin program will be an asset,
- good communication skills in written and spoken English are necessary for efficient completion of the doctoral thesis.

Funding:

Scholarship: grant funding of 5000 PLN per month, before subtracting obligatory employer and employee social security contributions (~15%), for 33 months. Afterwards, standard Polish PhD scholarship (about 2360 PLN/month net in years 1-2, 3640 PLN/month net in years 3-4).

Contact: eilczuk@ifpan.edu.pl