**Projekt 4.33 Quantum heterostructures based on ZnO:Eu for optoelectronics – structural characterization and optimization of growth technology**

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**Background:**
Red luminescence from wide band gap semiconductors is a key technology for realizing novel light-emitting devices such as integrated full-colour displays. To date, optoelectronic devices based on InGaN-compounds have achieved high performance in the near-ultraviolet to green spectral regions. However, using InGaN in the red spectral ranges remains a challenge at the higher In content due to the degraded crystalline quality of InGaN quantum wells and strong local internal piezoelectric fields in c-oriented active layers. In this project we propose another approach to red emitters, namely quantum structures based on ZnO doped with Eu (ZnMgO, ZnCdO layers and quantum wells). The emitted red light (~620 nm) defined by intra-atomic transitions of Eu does not vary much with host materials and temperature. Therefore, it is potentially possible to go out from technologically difficult compositions of nitride alloys to easier ones such as oxides. It is also possible to obtain stable emission wavelength of Eu, excited by current injection in homo- and hetero- p-n junctions, which leads directly to light emitting diodes (LEDs). No such studies at all in papers.

**Aim:**
The aim of the project in its first stage is optimization of technology of ZnO, ZnMgO and ZnCdO-based quantum structures doped with Eu and grown by molecular beam epitaxy (MBE). To realize this aim it is necessary to determine proper growth conditions which will allow to obtain the structures with very well defined interfaces and without composition gradients. It requires performing precise characterization of the structures with several experimental techniques such as X-ray diffraction, transmission and scanning electron microscopy, and photoluminescence. Secondary ion mass spectrometry will be used to see possible inter-diffusion of Eu ions across the quantum well/barrier interfaces and to control the uniformity of atomic composition. It is expected that the elaborated technology of MBE growth of such structures will be reliable and repeatable. No doubts that some technological solutions will be patented.

**Requirements:**
Master of Sciences in solid state physics (preffered), or in material sciences, or in chemistry, but with some interests in solid state physics; basic knowledge of experimental techniques mentioned above; knowledge of written and spoken English; some knowledge of principles (and practise) of MBE technology is welcome.