Inorganic nanoluminophores and their functionalized systems based on rare earth ions: application potential and new research perspectives

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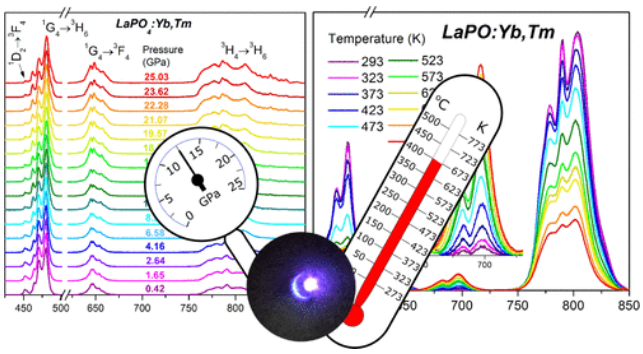
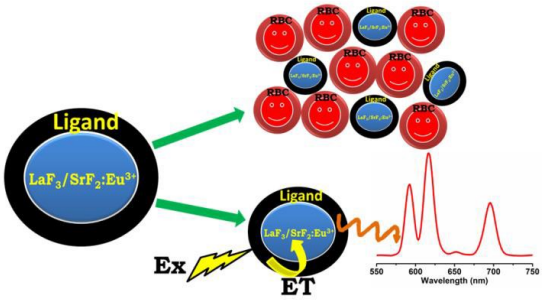
Luminescent nanomaterials containing rare earth (RE) ions are of great interest and due to their unique properties they can applied in various fields, such as optoelectronics, plasma displays, lasers, solar cells, lighting, forensic and security materials, as well as materials bio-related areas.
In my lecture I will present the results of our own investigations concerning selected nanomaterials based on inorganic matrices (e.g.: fluorides, borates, phosphates, vanadates, silicates, etc.) doped with the luminescent RE ions, which are characterized by high thermal and photochemical stability. As application materials, they should show: phase purity, high crystallinity and homogeneity, small particle size and narrow particle size distribution, and should not be agglomerated. Synthesized, under intentionally designed and optimal experimental conditions, nanoluminophores (NLs) and up-convering luminophores (UCNLs), core-shell surface functionalized nanoparticles (NPs) and multifunctional (e.g. luminescent-magnetic) hybrids have been characterized structurally and spectroscopically in detail. Selected NPs showing effective luminescence (of RE) and superpara-magnetism (of Fe_3O_4) have been successfully applied as multifunctional materials, e.g. as modifiers (luminescent/magnetic) incorporated into cellulose materials, which confirms the concept of advanced, multimodal protection of documents (clothing) against counterfeiting, or functionalized by chains of helical complexes of various lanthanide ions as building blocks in the design novel multifunctional nanosystems.



The successful application of the luminescent RE^{3+}/(and/or RE^{2+})-doped NPs as optical and multifunctional optical sensors for nanomanometry and nanothermometry (e.g. fluorides, phosphates, borates, vanadates) will be discussed.



Our research on luminescent (Eu^{3+}-doped) NPs functionalized with the desired organic (e.g. Aspirin, ibuprofen, aspirin) ligand molecules for hemocompatibility studies proved that the tested nanomaterials are highly biocompatible compounds in vitro and can be further investigated for biomedical application in vivo. In recent studies we demonstrated that luminescent NPs of CaF_2:Tb^{3+}(Eu^{3+})-caped organic ligands, can be successfully used luminescent probes, for the determination of metal species (WO_4^{2-}, MnO_4^-, Cu^{2+}) in water samples, using highly selective fluorescence methods, based on energy transfer from the analyte ion to the Tb^{3+}, (or Eu^{3+}) ions.

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