Abstract

This thesis is comprised of eleven published articles and one which is submitted to Scientific Reports journal, together with an Introduction, Motivations and Achieved Results chapters that describe the published articles in cohesive manner. This study investigates the effect of high hydrostatic pressure on luminescence related to the $4f^n$ - $4f^n$ and $4f^{n-1}5d^1$ - $4f^n$ transitions in lanthanide ions (Eu^{3+}, Eu^{2+}, Pr^{3+}, Tb^{3+}, Ce^{3+}) doped into several materials (oxide materials, fluorides, nitrides, oxynitrides, sialons). The unique ability of high pressure allows for the direct determination of the energy of localized states of impurity ions with respect to the energy edge of the conduction and valence bands of crystals. As it was shown for Ce^{3+} ions as an example, it is also possible to designate the energy of localized levels of impurities (relative to the vacuum level) and the energy of conduction and valence bands of crystals as a function of pressure. This study contributes to the understanding of the energy transfer processes, taking into account the role of exciton states such as STE (*Self trapped Exciton*) and ITE (*Impurity Trapped Exciton*) as well as the impact of the local environment around the impurity ions and global parameters of the crystal structure on the optical properties. These are fundamental studies which are nevertheless in the mainstream research of luminescent materials used for lighting and functional materials. The models that have been used to analyze the observed processes and for interpretation of the obtained results can be successfully applied to a broad class of luminescent materials due to their general nature.