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Abstract of doctoral dissertation: „The investigation of the influence of the chemical composition of the host material on the probability of thermally induced depopulation processes of the excited levels of the transition metal ions of $3d^3$ electronic configuration in inorganic oxide materials for applications in luminescence thermometry"

Luminescence thermometry is an experimental method of remote temperature determination using analysis of temperature dependence of the spectroscopic properties of phosphors. Its great popularity, observed in recent years, is mainly caused by the possibility of fast and accurate temperature readout in an electrically passive manner. The main requirement for a luminescent thermometer is its high accuracy of temperature determination, which mainly depends on the brightness of the material and its sensitivity to temperature changes. Therefore, increasing interest in this context is devoted to the phosphors doped with transition metal ions (TM), especially with the ions with $3d^3$ electron configuration (i.e. mainly Mn^{4+} and Cr^{3+}) due to their high luminescence brightness and the ease of optimizing their thermometric properties by modifying the chemical composition of the host material. Although the influence of host material stoichiometry on the thermal stability of Mn^{4+} and Cr^{3+} luminescence intensities has already been partially investigated, the lack of systematic studies enabling the selection of material parameters as well as the determination of their role in the thermal quenching of Mn^{4+} and Cr^{3+} emissions significantly hinders the design of highly sensitive luminescent thermometers. On the other hand, Mn^{4+} and Cr^{3+} ions can act as sensitizers for luminescent thermometers based on emission of other optically active ions - lanthanides (Ln^{3+}), what means that TM ions can increase the relative sensitivity of luminescent thermometer. For this purpose, it is necessary to select such a host-TM-Ln^{3+} system, which will enable an effective energy transfer from TM ions to Ln^{3+} ions. The use of TM ions as sensitizers of Ln^{3+} emission is particularly beneficial because of much higher absorption cross-section of TM ions in respect to the Ln^{3+}, which enables significant enhancement of the emission brightness of this type of phosphors. Such use of TM ions in luminescence thermometry has not been investigated systematically so far.

To sum up, the aim of this doctoral dissertation is to investigate the influence of the chemical composition and material parameters, such as the local symmetry of the crystals, the crystal field strength, the phonon energy etc., on the sensitivity of luminescent thermometers based on the ratio of the intensity of the emission bands of TM and Ln^{3+} ions and their luminescence lifetimes for transition metal ions with the $3d^3$ electronic configuration with special emphasis on Mn^{4+} and Cr^{3+} ions. Furthermore, the role of phosphor stoichiometry in the thermally dependent probability of the energy transfer between Mn^{4+} or Cr^{3+} ions and Ln^{3+} ions was investigated to improve the thermometric performance of thermometers based on the emission band ratio of lanthanide ions.