Mgr inż. Mikołaj Łukaszewicz
Department of Optical Spectroscopy
INTiBS PAN

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Summary of PhD Thesis

„Effect of temperature on spectroscopic properties of glasses and ceramics doped with erbium, neodymium and ytterbium"

Nowadays, the great attention of the research community is directed to the contactless temperature readout methods applying the optical spectroscopy techniques. Numerous papers show as the involved absorption spectra, emission spectra and luminescence decay curves may be successfully used to fast, precise and contactless temperature measurements. Dynamic development of this research area is stimulated by the promising medical applications. Optically active material in the form of single crystal, glass or nanocrystal is disturbed from thermal equilibrium after the excitation process. The part of the excitation energy is converted into photons emission and the other one is distributed as heat in nonradiative processes. Knowledge on the optical material temperature is relevant for both, better control of its optical qualities and to avoid of material damage caused by rapid elevation of temperature. In order to investigate the aforementioned phenomena, some research and experiments have been proposed applying dielectic materials doped with erbium, neodymium and ytterbium. It was analyzed as temperature of Y_2O_3:Er,Yb microcrystalline ceramic sample increases as function of various experimental conditions. Having regard to excellent thermal resistance of Y_2O_3, the additional model of thermometer was elaborated utilizing Planck thermal radiation within wide visible range and a significant complimentary of these examined methods was proved. The novel oxyfluoride tellurite glasses (TZPN) doped with Er^{3+} and Yb^{3+} as well as germanate-tellurite (GTSN) glasses doped with Nd^{3+} and Yb^{3+} have been investigated. The melt quenching method was used to obtain the amorphous materials and next, the considerable physicochemical, thermal and spectroscopic glass properties have been comprehensively analyzed. It was shown that the attained materials are characterized by good optical qualities that are important for applications in solid state lasers and optical amplifiers. The impact of temperature on the glass spectroscopic properties was examined for all obtained optical systems. The PhD thesis relevant objective was to examine the glass features and phenomena that are important for high-power optical systems investigating intensity of the involved optical bands and luminescence decay curves of thermally-coupled levels as function of temperature. Numerous reliable and complimentary methods of luminescent thermometry have been proposed and studied utilizing TZPN:Er,Yb and GTSN:Nd,Yb oxyfluorite glasses. It was documented that these investigated thermosensitive glass systems can be used as effective luminescent sensors operating with some alternative methods of temperature readout. The elaborated and examined approaches based on various methods were reliably verified preparing series of spectroscopic experiments in conditions of high-power excitation when the amorphous material is effectively heated.