Description for the general public

The photonic materials engineering is a rapid growing field of science. This is particularly evident in the development of new compositions of optical glasses developed to specific applications. Silica glass is well known example as far as is common used in optical telecommunications and high power fiber lasers. Other applications toward research to multicomponent glasses which has unique luminescent properties. Among such materials, a special one is germanate glass characterized by transmission in the range from 0.35 μm to 5 μm, good mechanical rigidity and thermal stability required in fiber optics technology and the relatively low-phonon energy. The last parameter is essential in germanate glasses doped with rare earth ions, where the effective emission is possible to obtain as a result of optical excitation. Literature reports indicate the possibility of using luminescent properties of active germanate glasses modified with various oxide and fluoride compounds, characterized by the emission of the mid-infrared range (2-3μm), in medical applications or environment protection. On the other hand, the great majority of papers are devoted to the conversion processes of the excitation energy from the infrared to the visible range which can be used in imaging technology, 3D displays or LED phosphors. The overwhelming number of studies are focus only on the specific spectral range of radiation and rarely the luminescent properties discussed in correlation to the structural features of the material, wherein the emission occurs. New research area, which is the subject of the project, concerns a complete description of the phenomena responsible for the formation of the luminescence spectrum in a specific spectral range related to the structural properties of the germanate glass. The main objective of the project is to systematize the relation between the interaction mechanisms of rare earth ions in germanate glasses doped with modifiers (with low- and high-phonon phase), with structure of vitreous network formed in the vicinity of rare-earth ion. This is particularly important, for the emission optimization (laser parameters) in new materials for waveguide structures (optical fibers), dedicated to use in a specified spectral range. Contribution to the collection of basic research will be the analysis of the impact of the modifier type on the luminescent properties of germanate glasses in correlation to the structural features of the developed glass network. Suggested issues comprise innovative character of basic research in the field of material engineering and photonics, behind which there is the explanation of the interaction rules of the luminescence signal shaping by controlling the structure of network of the fabricated germanate glasses. The project implementation brings new elements in the field of description of phenomena responsible for optimization of the emission efficiency in the glasses and optical fiber co-doped with lanthanide ions.