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Abstract of doctoral thesis "Multicomponent silicate glasses with high concentration of heavy metal oxides for photonic applications"

Doctoral thesis "Multicomponent silicate glasses with high concentration of heavy metal oxides for photonic applications" presents research results on obtaining of amorphous materials with target properties for photonic applications. Research includes borosilicate glasses with high concentration of alkali oxides and multicomponent silicate glasses with high concentrations of heavy metal oxides like lead oxide and bismuth oxide. The discussion contained in the work includes analysis of thermal and optical properties related to the different chemical compositions of the developed glasses.

Research problems involve development of special glasses with designed properties, which can be used for fabrication of two-dimensional optical fiber structures, such as fibers with complex photonic lattices, structured fiber microlenses or anisotropic structures with flat spectral characteristics of birefringence. The first research problem was obtaining high difference of refractive indices between two designed glasses, which together can be used for photonic fiber fabrication. Designing glasses with high refractive index contrast was performed for increasing fiber nonlinearity due to decrease of modal area and increase of optical density determining nonlinear optical effects, at the same time maintaining extended flexibility of chromatic dispersion designing. Furthermore this work contains discussion on the development of borosilicate glass including glass thermally compatible with commercially available lead silicate glasses F2 and SF6, and pair of borosilicate glasses with low refractive index difference for structured gradient fiber microlenses fabrication.

The second research problem was the development of multicomponent silicate glass with high concentration of heavy metal oxides for photonic fibers fabrication with transmission up to 4,5μm. Research includes property analysis of ternary lead bismuth silicate glasses and influence of metal oxides addition on thermal properties and glass crystallization susceptibility. The obtained results were used for development of high crystallization resistant glass from the SiO_2-Bi_2O_3-PbO-CdO-BaO oxide system, thermally compatible with lead bismuth gallium silicate glass. Obtained glass pair has similar transmission window reaching up to 4,5μm. Additionally, the influence of the synthesis conditions on the final thermal and optical properties of glasses were analyzed.

This work contains also research of nonlinear refractive index in multicomponent glasses for optical fiber technology, and application of multicomponent glasses in fabrication of passive optical elements (diffractive and refractive lenses) by the Hot Embossing technique.