The effect of composition on luminescence properties of Ce and Mn ions in borate-silicate glasses

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This contribution is focused on preparation of luminescent borosilicate glass able to improve intensity of UV-VIS solar radiation simultaneously in blue and red regions in order to support the growth of single-cell algae. Borate and borosilicate glasses doped with ions Ce^{3+} and Mn^{2+} were studied and a trade-off was found between luminescent properties and chemical resistance. The relationship between the oxidation states of the elements and the composition of the glass matrix was sought. Specifically, the effect of Mn concentration and content of network modificators (MgO, CaO, BaO) on strengthening of luminescence in the red region was studied in relation to optical basicity (Λ), which is an essential parameter affecting redox equilibrium and consequently the luminescence of glass. The optical basicity (Λ) was calculated from oxide contents in glasses and compared with experimental values obtained by use of Lorentz-Lorenz relation and Duffy correlation. Refractive indices and densities of glasses needed were obtained by means of m-line spectroscopy and pycnometry. The oxidation states of cerium and manganese were studied by XPS and EPR. Absorption and fluorescence spectra in UV- VIS region were also measured. Fluorescence spectra were measured for vast ranges of excitation and emission wavelengths then the measurement was repeated for chosen wavelengths with greater precision. The results show that the silicate glass containing 15% of B_2O_3 and 1% of MnO possesses measurable luminescence in blue and red region under 320 nm excitation. The intensity of luminescence can be affected by change of optical basicity of glass matrix, however the luminescence in red region is still too weak for practical application.

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