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Multinuclear MAS NMR study of structural changes in LaF_3 doped borosilicate glasses for optoelectronics

Marcin Sroda, Zbigniew Olejniczak

Keywords

oxyfluoride glass, borosilicate glass, glass structure, MAS NMR, LaF_3

Abstract

A new type of oxyfluoride glass-ceramics based on the silicate glassy matrix and the nano-phase of LaF_3 was developed for generating the up-conversion luminescence processes. In such material, the low-phonon energy crystals of LaF_3 are desirable host for the rare-earth elements. The effect of admixture of 3 mol% of La_2F_6 on the structural changes of glasses in the Na_2O–B_2O_3–SiO_2 system was investigated. The effect of LaF_3 additive was studied using ^{29}Si, ^{11}B, and ^{23}Na MAS NMR to learn more about the structural role of modifiers as well as fluorine in the glassy matrix. Glasses with compositions corresponding to different B_2O_3/Na_2O and $B_2O_3/(Na_2O + 3La_2F_6)$ ratios in the 0.6–1.2 range were obtained by melt quenching. The ^{29}Si MAS NMR spectra indicated that the $[SiO_4]$ units are more polymerized when the ratios and the fluorine admixture increase. The ^{11}B NMR spectra revealed the presence of both $[BO_4]$ (Q^4) and $[BO_3]$ (Q^3) units. The fraction of Q^3 increased with the decreasing sodium content. Glasses with the LaF_3 additive showed higher BO_3/BO_4 ratios. The effect of thermal treatment for glasses with the tendency towards LaF_3 crystallization was discussed in terms of structural changes.

460.6 kB

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