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Specific features of lithium-gadolinium borate $Li_6GdB_3O_9$ manufacturing

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Using differential thermal analysis as well as X-ray phase and chemical ones, the formation of lithium-gadolinium borate $Li_6GdB_3O_9$ (LiGdBO) phase in the Li_2O–Gd_2O_3–B_2O_3 oxide system has been studied. The formation and melting temperatures of LiGdBO compound have been found to be (660±5) and (835±5)°C, respectively. The compound exhibits a strong melt overcooling at the crystallization that increased as the overheating temperature grows. The manufacturing conditions of raw material for LiGdBO crystal growing have been determined.

Методами дифференциально-термического, рентгено-фазового и химического анализов изучено образование фазы литий-гадолиниевого бората $Li_6GdB_3O_9$ (LiGdBO) в системе оксидов Li_2O–Gd_2O_3–B_2O_3. Определены температуры образования (660±5)°C и плавления (835±5)°C соединения LiGdBO. Установлено, что это соединение характеризуется сильным переохлаждением расплава при кристаллизации, возрастающим с повышением температуры перегрева. Определены условия получения шихты для выращивания монокристаллов LiGdBO.

Borate compounds of alkali, alkali-earth, and rare-earth elements have drawn a great attention during last few years [1]. Single crystals of these compounds show a set of properties being of interest for non-linear optics and acoustics [2, 3] as well as in scintillation technique [4, 5]. A novel scintillator for thermal neutron detection, the lithium-gadolinium borate $Li_6GdB_3O_9$ single crystal, is among those materials [4–7]. This material was not studied systematically before and the specific features of its manufacturing are not described in literature.

In particular, there are no data on the phase diagram of Li_2O–Gd_2O_3–B_2O_3 ternary oxide system. The diagram is difficult to construct due to well-known peculiarities of borates, namely, the volatility, trend to polymerization, glassing, and polymorphism, high viscosity and overcooling of melts [8]. The lack of experimental data at least on the phase formation sequence in that system and their stability, the formation temperature interval and the homogeneity region limits, and on the phase composition of crystallization products gives rise to problems associated both with the solid phase synthesis of LiGdBO compound and the controlled crystallization of the corresponding melt. The melting of that LiGdBO has been affirmed to be of congruent character [7] but no experimental data are presented confirming this information. We have shown that it is possible to grow LiGdBO single crystals from the melt by Czochralski technique [1, 9]; this fact may evidence to some extent that the compound melts congruently. This work is aimed at the study of the solid phase synthesis conditions of stoichiometric $Li_6GdB_3O_9$ in the Li_2O–Gd_2O_3–B_2O_3 oxide system and of peculiarities of its melting and crystallization.

The samples for the study were prepared using ceramic technology. The initial components weighed to ±0.0001 g were mixed