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GLASS FORMATION OF OXIDE SYSTEM BY CONTAINERLESS PROCESSING AND LARGE SIZE APPLICATION

Abstract

The containerless processing is a unique method to create new glasses, because it suppresses nucleation at the interface between liquid and crucible during solidication and it enables molten samples to be solidied without crystallization by forming free interface. Using containerless processing with an aerodynamic levitation furnace, LaO3/2TiO2 binary and LaO3/2TiO2ZrO2 ternary glasses were synthesized in bulk form. First, based on the starting compound of La4Ti9O24, LaO3/2TiO2 system was investigated. Secondly, from the following three aspects; (i) enhancement of glass forming ability, (ii) maintaining high refractive index nd, and (iii) widening the Abbe number d that varies with compositions of glasses, ZrO2 was selected as the third component with La-Ti-O system. As for (i), large single bonging strength of ZrO conection is appropriate for building/ connecting glass-network. Besides, ion binding ratio in ZrO is suitable for network formation. As for (ii), molar refractive index Rm and molar volume Vm of each cation La3+, Ti4+, Zr4+ that affects the glass property, ZrO2 addition does not decrease nd . As for (iii), inherent wavelength0 of Zr4+ was expected for increasing Abbe Number. The glass transition temperature Tg and the crystallization onset temperature Tx of the obtained glasses were determined by dierential scanning calorimetry. The thermal stability was evaluated by T (=Tx Tg). By comparing values of T and glass-forming region in binary glass with those of ternary glass system, ZrO2 substitution was found to be effective for stabilizing the vitrification. The wavelength dispersion of the refractive indices was measured by spectroscopic ellipsometry. It was found that these glasses had outstandingly high refractive indices over 2.26 in nd. In addition, they were colorless and transparent, which means promising candidate for new optics materials. The high refractive index nd of these glasses was due to their closed oxygen packing densities. Wider range of Abbe number d was achieved in LaO3/2TiO2ZrO2 ternary glass by expanding the glass forming region compared to that of LaO3/2TiO2 binary glass. The inherent absorption wavelength 0 of Ti4+ played the dominant role in shifting the Abbe number d in ternary system that nine times wider than that of binary system. Large size diameter glass materials will be also reported by using unique technology.