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Heat Treatment Enables Translucent Oxyfluoride Glass Ceramics Transparent

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Oxyfluoride glass-ceramics (GCs) have recently been regarded as the ideal optical host materials for rare earth (RE) ions.[1,2] However, their luminescent efficiency is low owing to several obstacles such as small fluoride nanocrystals, low crystallinity, and decreased transparency. In this study, we reported a novel translucent precursor glass-ceramic (GC) containing Ba_2LaF_7 single crystals with large size (above 200 nm), which was prepared by the melt-quenching method. This means that crystallization took place during melt-quenching. The optical transmittance of the translucent precursor GC greatly increased with an increase of the isothermal treatment temperature, and this is attributed to both the growth of the existing flower-like Ba_2LaF_7 single crystals and the formation of small spherical Ba_2LaF_7 single nanocrystals. We identified the optimum heat-treatment temperature, which gave both the highest transmittance and luminescence intensity. To observe their separated phases, we determined crystal morphologies, the atomic arrangement of the single crystals, and local coordination environments of both precursor GC and three heat-treated GC samples by using X-ray diffraction, scanning electron microscopy, high-resolution transmission electron microscopy, and solid-state nuclear magnetic resonance, respectively. We analyzed their refractive index and revealed that the refractive index differences between the Ba_2LaF_7 single crystals and residual oxide glass matrices were minimized (< 0.01) by increasing the heat treatment temperature. The new results give insight into amorphous phase separation and crystallization behavior in this studied precursor GC.[3] The heat-treated GC will be a great potential candidate to achieve micro-laser outputs based on high transmittance and crystallization.[4,5]

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