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Crystallization, structure and properties of MgO-Al_2O_3-SiO_2 highly crystalline transparent glass-ceramics nucleated by multiple nucleating agents

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Abstract

Generally, highly crystalline transparent glass-ceramics possess excellent physical and chemical properties compared to organic and other inorganic optical materials. We have successfully prepared highly crystalline transparent glass-ceramics in the MgO-Al_2O_3-SiO_2 system by "extreme-time" nucleation & "finite-time" crystallization processes using P_2O_5, ZrO_2 and TiO_2 as multiple nucleating agents. The results revealed that the crystallization of glass is controlled by a three-dimensional interfacial crystal growth process. These glass-ceramics mainly consisted of cordierite crystals with a residual glassy phase, and crystallinity increased with crystallization time, but light transmittance decreased with crystallization time due to enlarged grain sizes. EDS mapping revealed a uniform distribution of elements within the glass-ceramic. In the optimal preparation condition (825 °C/96 h + 990 °C/3 h), these glass-ceramics exhibited a high crystallinity (87.3 vol. %), high transmittance (78 %), and excellent mechanical

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