Transparent ceramics of $LiAl_5O_8$ prepared by spark plasma sintering

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Transparent ceramics are a relatively new material form that serves as an alternative to the traditionally encountered glasses, polymers or highly transparent single crystals. They have found application in a variety of optical and electro-optical devices such as solid state lasers and scintillators, but also in some non-optical applications, e.g. armours. The fabrication of transparent ceramics usually involves a combination of chemical and physical processes, which are used to prepare a ceramic powder and compact the powder into a dense ceramic body. However, the optical properties of finished polycrystalline ceramics are closely related to their microstructure and to the presence of defects in it. Residual pores (located within grains or at grain boundaries), impurities or the actual grain boundaries (especially for optically anisotropic materials) are sources of light scattering, which deteriorates the optical properties of transparent ceramics. Therefore, transparent ceramics are commonly prepared from materials with an optically isotropic cubic structure using high purity powders, which leave porosity as the most significant factor for transparency.

In this work, the preparation of $LiAl_5O_8$ transparent ceramics is presented using spark plasma sintering (SPS). Powder precursors were prepared using two methods, namely the sol-gel method and the solid state reaction. Before sintering, the powders were heat treated at a high temperature of 1100 or 1200 °C and their phase composition was verified by XRD to be a pure cubic α-phase of $LiAl_5O_8$. The powders were compacted into dense ceramic bodies by SPS, which were further processed by grinding and polishing to achieve a mirror finish and a thickness of approximately 1 mm. The transmittance and microstructure of the sintered ceramics were investigated to determine optimal conditions for the powder preparation and its sintering. Transparent ceramics with transmittance greater than 75 % at 500 nm was achieved.

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