

The effect of high-pressure induced plasticity on the microstructure and properties of nano-structured transparent ceramics fabricated using high-pressure spark plasma sintering

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Transparent ceramics have great potential for applications in lasers, optical systems, armor and nuclear technologies. Magnesium aluminate spinel is a promising transparent ceramic that can be prepared by conventional multi-stage processes. However, single-stage spark plasma sintering (SPS) is a less time-consuming approach. Polycrystalline alumina is another widely used engineering ceramic. However, α -Al₂O₃ is birefringent (hexagonal crystal structure). Hence, high transparency in the visible domain can be only obtained with very low residual porosity (< 0.1%) and grain sizes smaller than the incident light wavelength to limit scattering losses. In this work, high-density nanostructured MgAl₂O₄ and α -Al₂O₃ ceramics were produced by high pressure SPS (HP-SPS) up to 5 GPa. High pressure densification produces green bodies with fine pores and high density, which improves the sintering process. In fact, application of 1.5 GPa pressure reduces significantly sintering temperatures (< 1000°C), resulting in dense, transparent ceramics without grain coarsening. It has been shown that high pressures induce not only high green density but also plasticity within the ceramic nanoparticles. The objective is to understand how this plasticity modifies the sintering mechanism and affects the final properties. Advanced analysis techniques have been used to monitor microstructure evolution and properties under high pressure and temperature (SEM, TEM, Real in line transmission, Hardness tests).

Professional Status of the Speaker

Senior Scientist

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