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Marais, Francois Pierre

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An Inquiry into Magnesium Aluminate Spinel as an Advanced Engineering Ceramic



UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Francois Pierre Marais

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Abstract

Magnesium aluminate spinel has been investigated as a potential candidate for both optical applications and refractory applications. Transparent polycrystalline magnesium aluminate spinel is a potential candidate for the replacement of fused silica glass used in transparent armour and windows of space craft. A single stage spark plasma sintering process has been used, in conjunction with the sintering aid LiF, to fabricate transparent magnesium aluminate spinel. The spark plasma sintering process used resulted in a spinel disk with a relatively high transmission for a single stage sintering process (the average in the visible spectrum was ≈72%), but relatively poor mechanical properties. Of particular concern was the low Weibull modulus. Independently, an investigation into the effect of the addition of tetragonal-ZrO_2 into the spinel matrix was investigated. Spinel materials' generally poor mechanical properties prevent its utilisation in many refractory applications even though it has excellent chemical and thermal stability. The addition of tetragonal-ZrO_2 was observed to improve the hardness, fracture toughness and biaxial flexural strength of the spinel. Furthermore, the addition of 3mol% Y_2O_3 – ZrO_2 resulted in a reduction of the grain size. The results also indicated that the addition of ZrO_2 improved spinel's high temperature resistance.