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# Polycrystalline Transparent Magnesium Aluminate Spinel Processed by a Combination of Spark Plasma Sintering (SPS) and Hot Isostatic Pressing (HIP)

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## Abstract

A two-stage processing approach combining spark plasma sintering (SPS) and hot isostatic pressing (HIP) was employed for the fabrication of relatively large (30 mm diameter) and thick (up to 8 mm) samples of transparent polycrystalline magnesium aluminate. The effects of sample thickness, heating rate during SPS, and the temperature and duration of HIP treatments were investigated. It was established that the heating rate during SPS had a major influence on discoloration due to carbon contamination, which increased with sample thickness. HIP treatment allowed for the elimination of cloudiness due to samples porosity, although carbon contamination present after the SPS step could not be reduced by HIP treatment, regardless of the temperature and duration applied. Highly transparent specimens with thicknesses of 4 and 8 mm exhibiting an in-line transmittance of 85.2 and 83.2% at 600 nm, respectively, were fabricated.

**Keywords:** Magnesium aluminate spinel ($MgAl_2O_4$); Transparent ceramic; Spark plasma sintering; Hot isostatic pressing

## 1. Introduction

Transparent polycrystalline magnesium aluminate spinel (PMAS) has promising potential for many applications (e.g., transparent armor, UV lithography windows, spacecraft, night-vision systems, laser ignitions and more) due to its unique optical and mechanical properties [1-3].

A conventional approach for transparent PMAS fabrication involves cold isostatic pressing (CIP) or slip-casting and prolonged pressure-less sintering (PLS) of