

## عنوان مقاله:

A simulative approach to obtain higher temperatures during spark plasma sintering of ZrB<sub>2</sub> ceramics by geometry optimization

## محل انتشار:

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## خلاصه مقاله:

This study provides a detailed analysis of the Spark Plasma Sintering (SPS) process for Zirconium Diboride (ZrB<sub>2</sub>) ceramics, utilizing the finite element method in COMSOL Multiphysics. The focus is on understanding the temperature distribution during the SPS of a ZrB<sub>2</sub> sample in a graphite die. Heat diffusion equations, augmented with Joule heating considerations, are utilized to simulate temperature variations within the system over time. Critical boundary conditions at the system's extremities are modeled as convection cooling. The Analysis of Variance (ANOVA) reveals that the diameter of the sample is the most significant factor influencing the peak temperature at the center of the ZrB<sub>2</sub> sample. It is found that the sample diameter's variance accounts for a predominant impact on temperature, markedly more than other factors such as the die's outer diameter and sample thickness. Notably, the standard deviation of the temperature in the axial direction across all samples is less than ۴ °C, a value that is statistically minor in comparison to the sintering temperatures, which are around ۲۰۰۰ °C. These findings are instrumental in providing an in-depth understanding of the SPS process, which is essential for the optimization of sintering parameters for ZrB<sub>2</sub> ceramics. This study provides a detailed analysis of the Spark Plasma Sintering (SPS) process for Zirconium Diboride (ZrB<sub>2</sub>) ceramics, utilizing the finite element method in COMSOL Multiphysics. The focus is on understanding the temperature distribution during the SPS of a ZrB<sub>2</sub> sample in a graphite die. Heat diffusion equations, augmented with Joule heating considerations, are utilized to simulate temperature variations within the system over time. Critical boundary conditions at the system's extremities are modeled as convection cooling. The Analysis of Variance (ANOVA) reveals that the diameter of the sample is the most significant factor influencing the peak temperature at the center of the ZrB<sub>2</sub> sample. It is found that the sample diameter's variance accounts for a predominant impact on temperature, markedly more than other factors such as the die's outer diameter and sample thickness. Notably, the standard deviation of the temperature in the axial direction across all samples is less than ۴ °C, a value that is statistically minor in comparison to the sintering temperatures, which are around ۲۰۰۰ °C. These findings are instrumental in providing an in-depth understanding of the SPS process, which is essential for the optimization of sintering parameters for ZrB<sub>2</sub> ceramics.

## کلمات کلیدی:

Zirconium diboride, Numerical analysis, Taguchi method, Temperature distribution, SPS

## لینک ثابت مقاله در پایگاه سیویلیکا:

