

Microstructural and Thermal Properties of a ZrO_2 –30 wt% Diamond Composite Sintered by the SPS Method

Tuesday, 1 September 2026 18:10 (20 minutes)

Zirconia and alumina are widely used for wear-resistant components, while zirconium oxide also serves as a thermal barrier material. Diamond, with the highest thermal conductivity among all materials, can potentially improve the thermal shock resistance of zirconia. However, producing oxide–diamond composites is challenging due to the high sintering temperatures required for ZrO_2 and the tendency of diamond to graphitize under pressureless or low-pressure conditions. Direct sintering may also cause oxide reduction, carbon monoxide formation, and poor bonding between zirconia and diamond.

In this study, ZrO_2 –30 wt% diamond composites were produced indirectly. Zirconium powder with 3 mol% Y_2O_3 and 30 wt% diamond powder was milled for 8 h in a planetary mill using zirconia milling media, enabling zirconium deposition on diamond surfaces. The powders were oxidized at 600 °C for 1 h and this process was repeated three times with intermediate mixing.

Sintering was carried out at 1250°C for 4 min in air using Spark Plasma Sintering. X-ray diffraction showed that the matrix mainly consisted of tetragonal ZrO_2 , with minor monoclinic ZrO_2 and ZrO_3 phases. Microstructure was analyzed by X-ray computed tomography, while thermal diffusivity and conductivity were measured using the laser flash method.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

Journal of the European Ceramic Society (Elsevier)

Invitation letter for visa

No

Author: Dr TYRAŁA, Dorota (AGH University of Krakow, Faculty of Metals Engineering and Industrial Computer Science)

Co-authors: Dr RUTKOWSKI, Paweł (AGH University of Krakow, Faculty of Materials Science and Ceramics); Dr PODSIADŁO, Marcin (Lukasiewicz Research Network - Krakow Institute of Technology); Prof. JAWORSKA, Lucyna (AGH University of Krakow, Faculty of Metals Engineering and Industrial Computer Science); Dr WITKOWSKA, Małgorzata (AGH University of Krakow, Faculty of Metals Engineering and Industrial Computer Science); Dr TCHÓRZ, Adam (Lukasiewicz Research Network, Krakow Institute of Technology); Dr KLIMCZYK, Piotr (Lukasiewicz Research Network - Krakow Institute of Technology)

Presenters: Dr TYRAŁA, Dorota (AGH University of Krakow, Faculty of Metals Engineering and Industrial Computer Science); Prof. JAWORSKA, Lucyna (AGH University of Krakow, Faculty of Metals Engineering and Industrial Computer Science)

Session Classification: Poster Session

Track Classification: Group 3: Field assisted sintering technology/Spark Plasma Sintering FAST/SPS