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EFFECT OF SPARK PLASMA SINTERING ON DENSIFICATION AND MECHANICAL PROPERTIES OF $\text{LaPO}_4\text{-ZrO}_2$ COMPOSITES

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It recently has been found that when LaPO_4 with a high melting point of $2072 \pm 20^\circ\text{C}$ ¹ was added to other refractory oxides, such as Al_2O_3 (melting point, 2050°C) or ZrO_2 (melting point, 2700°C), the machinable composites with high strength and high melting temperature could be obtained. In this work the spark plasma sintering (SPS) technique was used to manufacture $x\text{LaPO}_4\text{-(1-x)ZrO}_2$ ($x = 0$ to 1) composites. The mixture of LaPO_4 and ZrO_2 powder was sintered in a graphite die at 1300°C , 40 MPa for 2 to 3 min in a vacuum. Usual pressureless-sintering technique was also used to compare the properties. The sintered composites were found to be machinable. The SPS method gives dense sintered bodies with the relative densities above 96% whereas the relative densities of composites sintered by pressureless sintering method is above 90%. The mechanical properties obtained by SPS had higher strength (387 MPa, $x = 0.3$) and fracture toughness ($4.3 \text{ MPa}\cdot\text{m}^{1/2}$, $x = 0.3$) than those obtained by pressureless-sintering (148.6 MPa, $3.1 \text{ MPa}\cdot\text{m}^{1/2}$). The results show that the SPS method increases density and bending strength of the composites; it, however, weakens the machinability.

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