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Microstructure and fracture toughness of a spark plasma sintered Al_2O_3-based composite with $BaTiO_3$ particulates

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Abstract

Dense Al_2O_3-based composites with dispersed $BaTiO_3$ particulates were fabricated by using spark plasma sintering (SPS) at sintering temperatures between 1100 and 1500 °C with a heating rate of 100 °C/min. High-density of $BaTiO_3$–Al_2O_3 with various compositions could be achieved by SPS at lower sintering temperatures compared to those by conventional pressure-less sintering (PLS). However, full densification was prevented by the onset of abnormal grain growth in Al_2O_3–$BaTiO_3$ composites sintered by SPS. It was found that SPS process could accelerate the abnormal grain growth due to the activation and purification of particle surface. The addition of $BaTiO_3$ in Al_2O_3 matrix improved fracture toughness of the composites fabricated by both SPS and PLS. The highest fracture toughness of 6.04 MPa.$m^{1/2}$ was achieved in the composite sintered by SPS process with 5 mol% $BaTiO_3$, while that of the monolithic Al_2O_3 was about 4.0 MPa.$m^{1/2}$.

Keywords: Al_2O_3; $BaTiO_3$; Composites; Sintering; Toughness and toughening