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Alumina-Titanium Functionally Graded Composites produced by Spark Plasma Sintering

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Abstract

The joining conditions of alumina (Al_2O_3) and titanium (Ti) were studied to produce relatively light materials combining a high hardness and ductility at ambient temperature. The starting Al_2O_3 and Ti in the form of powders were sintered by spark plasma sintering (SPS). The joining required Al_2O_3/Ti composite interlayers. Ti, Al_2O_3 and composites were separately sintered and characterized in terms of their microstructure and mechanical properties. Tensile tests were performed to evaluate the ductility of titanium. Hardness and toughness were estimated from indentation tests of alumina and composites. Ti that was SPS-sintered in the same conditions as Al_2O_3, did not show the expected properties (absence of ductility) due to the formation of carbides and oxides. Al_2O_3, with its refined microstructure, was particularly hard. Regardless of their composition, composites were found to be more cracking resistant than pure Al_2O_3, despite the reactivity of titanium with alumina. The