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## Alumina-Titanium Functionally Graded Composites produced by Spark Plasma

### Sintering

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### Abstract

The joining conditions of alumina ( $\text{Al}_2\text{O}_3$ ) and titanium (Ti) were studied to produce relatively light materials combining a high hardness and ductility at ambient temperature. The starting  $\text{Al}_2\text{O}_3$  and Ti in the form of powders were sintered by spark plasma sintering (SPS). The joining required  $\text{Al}_2\text{O}_3/\text{Ti}$  composite interlayers. Ti,  $\text{Al}_2\text{O}_3$  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  $\text{Al}_2\text{O}_3$ , did not show the expected properties (absence of ductility) due to the formation of carbides and oxides.  $\text{Al}_2\text{O}_3$ , with its refined microstructure, was particularly hard. Regardless of their composition, composites were found to be more cracking resistant than pure  $\text{Al}_2\text{O}_3$ , despite the reactivity of titanium with alumina. The

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