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# Engineering of lightweight ceramic composites by spark plasma sintering

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## ENGINEERING OF LIGHTWEIGHT CERAMIC COMPOSITES BY SPARK PLASMA SINTERING

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**Key Words:** spark plasma sintering, reaction-driven consolidation, boron carbide, mechanical properties, high-temperature strength .

It is well recognised that value of porosity and grain size influences mechanical properties such as fracture toughness, elastic modulus and strength dramatically. Boron carbide ( $B_4C$ ), as well as other lightweight ceramics like  $TiB_2$ ,  $B_6O$  requires high consolidation temperatures owing to its poor sinterability. Therefore such decrease of ceramics properties becomes a materials processing issue since during consolidation process on the final stage of sintering (either pressure-assisted or pressureless one) grain growth starts. To overcome this problem, various metallic and non-metallic binders are used to obtain dense borides. However, the presence of a metallic binder is not desirable for high-temperature structural applications. We propose that reaction-driven consolidation by means of spark plasma sintering (SPS) at temperatures exceeding 1800 °C as an alternative method for fabrication of high-temperature lightweight ceramic composites.

This work summarizes recent activity on processing of lightweight ceramics based on boron carbide, boron suboxide and titanium diboride in the respect to mechanical properties: such as hardness, fracture toughness and room and high-temperature strength. Application of various techniques for powders preparation and consolidation by SPS is thoroughly discussed in respect to obtained lightweight ceramic composites properties. A thorough discussion of high-temperature properties for these ceramic composites is also provided.