Nano-composites and nanomaterials

Hard B_4C-AlB_{12} bulk composites by spark plasma sintering

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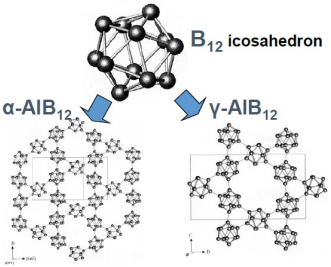

In aluminum dodecaboride B_{12} create 3D frame similar to polymers. As more boron bonds as stronger molecule is. Aluminum dodecaboride has 12 B atoms for every Al atom (B_4C has only 4 B for every C atom). The AlB_{12} structure should be much stronger than boron carbide.

We performed SPS fabrication and further comprehensive characterization of bulk B_4C –AlB_{12} composites (20 mm in diameter) starting from powder mixtures of B_4C and >5% wt. AlB_{12} by non-reactive approach in vacuum. Mixtures of B_4C and AlB_{12} powders of following compositions were prepared: $(B_4C)(1-x)$wt.% + $(AlB_{12})x$ wt.% with x=0, 5, 10, 20 and 30 wt.%.

In this work, we test for the first time consolidation of bulk B_4C-AlB_{12} composite. We report sample preparation, HV, K_{Ic} and SEM microstructure and XRD phase analysis for this new material. HV indentation measurements have shown maximum values of 37.8GPa for the samples with 20%AlB_{12}. K_{Ic} varied between 3.55 and 6.67 MPa.$m^{1/2}$. Result is encouraging, and further optimization of composition and the SPS consolidation technique is very promising.

Related publications:

1. I. Solodkyi, **H. Borodianska**, T. Zhao, TY. Sakka, P. Badica, and O. Vasylkiv**, "**B_6O ceramic by *in-situ* reactive spark plasma sintering of B_2O_3 and B powder mixture", ***J. Ceram. Soc. Japan***, 122 [4] (2014).
2. Bogomol**, H. Borodianska**, T. Zhao, T. Nishimura, Y. Sakka, P. Loboda and O. Vasylkiv, "Dense and tough (B_4C-TiB_2)-B_4C 'composite within a composite' by spark plasma sintering", ***Scripta Materialia***, 71 (2014) 17–20.
3. P. Badica, **H. Borodianska**, X. Shumao, T. Zhao, D. Demirskyi, P. Li, A. I. Y. Tok, Y. Sakka, and O. Vasylkiv, "Toughness Control of Boron Carbide Obtained by Spark Plasma Sintering in Nitrogen Atmosphere", ***Ceramics International,*** 40, 3053-3061 (2014).