

Author's Accepted Manuscript

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PII: S0272-8842(18)31922-9
DOI: <https://doi.org/10.1016/j.ceramint.2018.07.181>
Reference: CERI18903

To appear in: *Ceramics International*

Received date: 23 June 2018
Revised date: 4 July 2018
Accepted date: 20 July 2018

Cite this article as: Ke Ma, Xiaozhou Cao, Tao Jiang, He Yang and Xiangxin Xue, In situ synthesis, mechanical properties, and microstructure of reactively hot pressed WB₄ ceramic with Ni as a sintering additive, *Ceramics International*, <https://doi.org/10.1016/j.ceramint.2018.07.181>

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**In situ synthesis, mechanical properties, and microstructure of
reactively hot pressed WB₄ ceramic with Ni as a sintering additive**

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Abstract

In this study, tungsten tetraboride (WB₄) ceramics were synthesized in situ from powder mixtures of W and amorphous B with Ni as a sintering aid by reactive hot pressing method. The as-synthesized ceramics exhibited porosity as low as 0.375 % and ultra-high Vickers hardness (H_v), as much as 49.808 ± 1.683 GPa (for the low load of 0.49 N). It was seen that the addition of Ni greatly improved the sinterability of WB₄ ceramic. Besides, the flexural strength and fracture toughness of WB₄ ceramic were measured for the first time to be 332.857 ± 36.763 MPa and 4.136 ± 0.259 MPa·m^{1/2}, respectively, suggesting that the ceramic has good mechanical properties. The effects of sintering temperature and holding time on the densification, Vickers hardness, and mechanical properties of WB₄ ceramics were also investigated systematically as part of our study. The results indicated that increasing the sintering temperature can obviously improve the densification and mechanical properties of the ceramics. The bulk density and Vickers hardness of WB₄ ceramic sintered at 1650 °C for 60 min under 30 MPa revealed the highest values of 6.366 g·cm⁻³ and $27.948 \pm$

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