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Benefit of UHP-SPS for thermal sensitive (Al_2O_3) and thermal unstable (MgB_2) materials

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Abstract

Influence of pressure on the mechanical properties of hard and super-hard materials are well known. Combination of high pressure and field assisted sintering yields nanostructured ceramics, stabilization of thermosensitive phases and facilitate early chemical reaction. Recently there are few reports on the possibility to combine pulsed electric power source with HP toroidal type apparatus reaching pressure up to 7.8 GPa and temperature of 1950°C. In the present work, we used our in-house built ultra-high pressure SPS (UHP-SPS) [1-4] equipment with HP Belt type apparatus that enables to reach maximum pressure of 6 GPa and temperature up to 1800°C. For its versatility for syntheses and sintering, 2 materials are studied: for highly dense MgB_2 ceramics at low temperature help by the high pressure in comparison with conventional SPS and for α - γ phase transition Al_2O_3 to occur at less severe conditions help by pulse electric current in comparison with conventional HP-HT. The advantages and the flexibilities of the developed UHP-SPS will be discussed and the results and characterization of MgB_2 and Al_2O_3 will be presented in detail.

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