SYNTHESIS OF HIGH ENTROPY METAL DIBORIDES

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In our recent work, several five-component metal diborides, including $(Hf_{0.2}Zr_{0.2}Ta_{0.2}Nb_{0.2}Ti_{0.2})B_2$, $(Hf_{0.2}Zr_{0.2}Ta_{0.2}Mo_{0.2}Ti_{0.2})B_2$, $(Hf_{0.2}Zr_{0.2}Mo_{0.2}Nb_{0.2}Ti_{0.2})B_2$, $(Hf_{0.2}Mo_{0.2}Ta_{0.2}Nb_{0.2}Ti_{0.2})B_2$, $(Mo_{0.2}Zr_{0.2}Ta_{0.2}Nb_{0.2}Ti_{0.2})B_2$, and $(Hf_{0.2}Zr_{0.2}Ti_{0.2}Cr_{0.2}Ta_{0.2})B_2$, were synthesized [*Scientific Reports* 6:37946 (2016)]. Here, we critically compare several different synthesis routes to fabricate these refractory high-entropy diborides via spark plasma sintering and conventional sintering, with or without sintering aids. While the majority of the compositions formed single phase AlB_2 structures via spark plasma sintering, minor secondary oxide phases (mostly $(Zr, Hf)O_2$), as well as porosity, remained. The utilization of multi-step conventional sintering along with appropriate sintering aids, *e.g.*, boron carbide and carbon, allowed for the removal of secondary oxide phases as well as increasing the densification. Furthermore, conventional sintering led to improved homogenization of the different metal elements within the samples, which were verified by EDS mapping. Results on the process optimization for both spark plasma sintering and conventional sintering of the materials, as well as initial measurements of mechanical properties, will be presented and discussed.

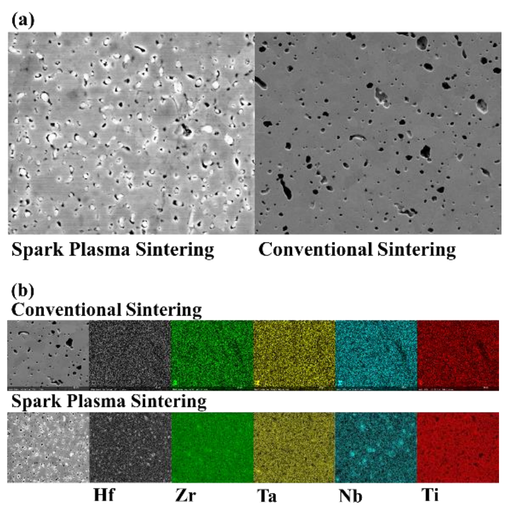

Fig 1: (a) SEM backscatter images and (b) corresponding EDS elemental maps of the conventionally and spark plasma sintered $(Hf_{0.2}Zr_{0.2}Ta_{0.2}Nb_{0.f2}Ti_{0.2})B_2$ samples.

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