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Self-compacting high density tungsten-bronze composites

Abstract

Green compacts of W–bronze were encapsulated in shells of bronze powder, placed in a ceramic mold and sintered in alumina tube furnace at 1150 °C. Throughout the sintering cooling stage the differential coefficient of thermal expansion ΔCTE of W–bronze was employed to induce an external compressive densification action. The process included simultaneous sintering, hot isostatic pressing (HIP) and infiltration act to enhance densification. By this technique, pilot sintered compacts of different W50–80 wt.%–pre-mix bronze of 97–99% theoretical density were produced. This process resulted in compacts of higher hardness, higher sintered density and better structure homogeneity as opposed to similar compacts densified by the conventional sintering process. The results showed a gain in hardness by 10–20% and in density by 5–15%. The impact of different cooling rates of 3, 4, 8 and 30 °C min^{-1} on sintered density, microstructure and densification mechanisms was examined and evaluated. Low cooling rates of 3 and 4 °C min^{-1} gave the best results.

Keywords; Coefficient of thermal expansion, Densification, Sintering, Tungsten–bronze composite