

The Effect of the Preparing Methods of Me + Al (Me = Ti, Ni, Ru) of Powder Blends on Compaction Features, Structure-Phase Transformations and Properties of Transition Metal Aluminides Compacts

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Abstract

The effect of the preparation methods of powder blends by traditional milling (Me+Al powders), attriting (Me/Al/ Me/Al composite powders), plating of Me by Al (Me/Al composite powders) on the structure, internal stresses and ability to consolidation as well as structure, phase composition and properties of MeAl compacts were investigated. During the cold pressing consolidation, followed by sintering, hot pressing or hot isostatic pressing the exothermic reaction $Me+Al \leftrightarrow MeAl$ in the powder blends is developed at $T \geq 650^\circ\text{C}$. Whether the powder preparation methods and consolidation conditions reaction sintering (RS) or high temperature self propagation synthesis (HTSPS) due to the exothermic reaction between Me and Al occurs in some steps through the formation of Al-melt (liquid-phase reaction) and low-melting ($MeAl_3$, Me_2Al_3 , Me_3Al) aluminides, some times through the solid-phase exothermic reaction at $\geq 300^\circ\text{C}$. The compacts of full or near full density had the equilibrium phase composition, homogeneous distribution of all phases including strengthening interstitial phases. The problems of the mass transfer intensity and decreasing temperature of the exothermic reaction onset are discussed. The high temperature mechanical properties of some powder alloys and composites in as-compacted state or after subsequent thermo-mechanical treatment were studied.