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TiC-Ni金属陶瓷自蔓延高温合成中的
显微组织演变肖国庆^{1, 2}, 范群成¹, 顾美转¹, 金志浩¹

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摘要: 用燃烧波淬熄法研究了TiC-Ni金属陶瓷自蔓延高温合成(SHS)中的组织演变, 淬熄试样中保留了未反应区、反应区和已反应区。用扫描电子显微镜观察了燃烧反应中显微组织的转变过程, 用能谱仪分析了各微区的成分变化, 测量了燃烧温度 T_c 和燃烧波蔓延速度, 并用XRD分析了反应产物的相组成。结果表明, TiC-Ni金属陶瓷自蔓延高温合成(SHS)的机理为溶解-析出机制, 镍粉与钛粉的固态扩散导致低熔点Ti-Ni溶液形成, Ti、Ni、C粉粒逐渐向Ti-Ni溶液中溶解, 当Ti-Ni-C溶液中的Ti和C浓度饱和时, 从中析出TiC颗粒, 同时形成粘附TiC颗粒的Ni₃Ti基体。分析结果表明, 该体系的燃烧合成具有不完全性, 最终产物中残留少量Ni₃Ti₂+NiTi共晶体, 这种反应的不完全性是由于使用了较粗的Ti粉和Ni粉。

关键词: TiC-Ni; 金属陶瓷; 自蔓延高温合成; 组织演变Microstructural evolution during self-propagating
high-temperature synthesis of TiC-Ni cermetXIAO Guo-qing^{1, 2}, FAN Qun-cheng¹,
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Abstract: The microstructural evolution during self-propagating high-temperature synthesis (SHS) of TiC-Ni cermet was studied by means of the combustion front quenching method. The process of microstructure conversion in the quenched sample was observed using a scanning electron microscope (SEM), a compositional change in each micro-region of the microstructure was studied by energy dispersive X-ray (EDX), the temperature and the velocity of combustion reaction were measured. The results show that the mechanism of combustion synthesis of TiC-Ni composition can be described as dissolution-precipitation. Ti-Ni melt is formed through solid diffusion between titanium and nickel powders, then the atoms of Ti, C and Ni gradually dissolve into the Ti-Ni melt, and TiC particles will precipitate from the Ti-Ni-C melt as the Ti-Ni-C melt is saturated, at the same time, the Ni₃Ti matrix forms, which binds the TiC particles. In addition, the results show that the combustion synthesis is possibly incompleteness because of coarser Ti and Ni powders used in the combustion synthesis, a small amount of eutectic, (Ni₃Ti₂+NiTi) is found in the final product. This incompleteness of the combustion reaction is attributed to using coarser Ti and Ni powders in the combustion synthesis.

Key words: TiC-Ni; cermet; self-propagating high-temperature synthesis; microstructural evolution

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