層狀三元碳化物之燃燒合成研究

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摘 要

本研究係以自持傳遞高溫合成法(Self-propagating High-temperature Synthesis, SHS)，在氬氣環境下進行燃燒合成層狀三元碳化物Ti3SiC2、Ti3AlC2、Ti2AlC、Ta2AlC以及複合材料TiAl-Ti2AlC，並於實驗中觀察不同起始粉末與試片密度對火焰鋒面傳遞模式、燃燒溫度、火焰鋒面傳遞速度反應後試片型態之影響，並詳細觀察不同反應物與產物生成之間的關係。 使用SHS法合成三元碳化物時，皆具有一些共同特性。當使用純元素粉末來進行反應，元素碳源為碳黑時，燃燒後的試片外徑縮小，長度拉長的現象；若碳源改為石墨，則燃燒後的試片會整個縮小；若試片中添加TiC來參予反應，則反應後試片外觀不會有太大變化。在燃燒溫度與火焰鋒面傳遞速度方面，使用純元素粉末來進行反應，元素碳源為碳黑時，燃燒溫度與火焰鋒面傳遞速度會較快，並且會隨著試片密度的不同而有所改變；若元素碳源改為石墨，或者添加TiC、SiC、Al4C3來參予反應，皆會降低燃燒溫度與火焰鋒面傳遞速度。而產物的微結構觀察，發現Ti3SiC2與Ta2AlC之結構為長條狀；而Ti3AlC2與Ti2AlC之結構類似平板狀，並以堆疊的方式層層堆疊。 在產物分析方面，於Ti3SiC2實驗中當添加20 mol% TiC時，可得到最高Ti3SiC2產率約為84.8 vol%；而添加20 mol% SiC時，可得到約83.8 vol%的Ti3SiC2。而在Ti3AlC2實驗中，當添加20.0 mol% TiC時，可達得到最高的Ti3AlC2產率約為84.6 wt%。Ti2AlC產物分析方面，生成主要產物Ti2AlC以及微量產物TiC，並且當TiC添加量為14.3 mol%時，可得到約89.2 wt%的Ti2AlC產率。而Ta2AlC之實驗則較特別，當增加反應物中Al含量可提高Ta2AlC產率，當使用Al含量達42.3 mol%時，產物幾乎僅存Ta2AlC與Ta4AlC3。在複合材料TiAl-Ti2AlC的部分，當生成Ti2AlC含量為40 ~ 60 mol%時，由XRD分析結果，產物與預期地相符只有TiAl和Ti2AlC存在，而生成其他TiAl/Ti2AlC比例，則反而會有其他次要產物Ti3Al與TiC的產生。

關鍵詞 : 自持傳遞高溫合成法 ; 三元碳化物 ; 火焰鋒面傳遞模式 ; 燃燒溫度 ; 火焰鋒面傳遞速度

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