利用固相置換反應於燃燒合成硼化鉬與其複合材料之研究

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摘 要

本實驗研究係以自持傳遞高溫合成法 (Self-propagate -ing High temperature Synthesis,SHS)於充滿氬氣環境燃燒室中燃燒 合成硼化鉬 (MoB) 並結合 MoO3 與硼的固相置換反應進行硼化鉬 Mo2B、MoB2、Mo2B5、 MoB4 四種化合物的燃燒合成，並探討其燃 燒反應之特性，研究其在氬氣壓力0.136 MPa、試片密度為 40%最 大理論密度時，其火焰鋒面傳遞模式、火焰鋒面傳遞速度、燃燒 合成溫度以及合成產物之影響與其複合材料各組態硼化鉬與氧化 鋁、MoB-MoSi2 與MoSi2-Al2O3 三種複合材料之結合，探討其燃 燒反應之特性。實驗結果顯示以SHS 合成MoB 之燃燒反應，其火 焰鋒面為平整穩定地傳遞模式，而藉由影像觀察之結果顯示出火 焰鋒面於預熱溫度較高的情形下試片會產生二次燃燒的現象，並 且在預熱溫度越高的情形下其火焰鋒面傳遞速度會有逐漸增加地 趨勢，而合成Mo2B、MoB2、Mo2B5、MoB4 之燃燒反應其火焰傳遞 模式為一平整的火焰鋒面穩定地向下傳遞，而藉由影像觀察之結 果發現試片會有明顯的膨脹現象與煙霧狀物質產生。而其火焰鋒 面傳遞速度皆隨著試片中硼化鉬組態之莫耳分率的提高，而有逐 漸下降的趨勢，這是因為在相對情形下置換反應中MoO3 含量相 對遞減的情形下，反應放熱能量變小，使其鋒面傳遞速度也隨著 下降。而燃燒反應之最高燃燒溫度也隨著試片中硼化鉬莫耳分率 的下降，而有逐漸上升的趨勢，與火焰鋒面傳遞速度有相對應的 關係。四種組態中最高燃燒溫度最高的為MoB2，其次則為Mo2B最 低的是Mo2B5 而MoB4 的實驗反應因為產物的生成大部分為Mo2B5 所以其燃燒溫度與Mo2B5 的實驗接近。利用XRD 分析產物的結果 中我們可以知道利用置換反應在生成MoB2與Mo2B5 兩種產物的成 果最好，而在生成Mo2B 方面則會有大量的Mo 殘留與生成些許的 α-MoB，而於合成 MoB4 方面，雖然提高其莫耳分率但主要產物 卻都是Mo2B5，僅能生成少許的 MoB4，三種產物的生成皆會有隨 著莫耳分率的提高而有逐漸變好的趨勢。

關鍵詞 : 自持傳遞高溫合成法，置換反應，火焰鋒面傳遞模式，火焰鋒面傳遞速度，燃燒合成溫度

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