

具純銀導電性之微奈米級銀銅殼核粉末合成研究 = A Study on Synthesis of Micro/Nano Silver-Copper Core-Shell Powder with an

彭御賢、李清華

E-mail: 360088@mail.dyu.edu.tw

摘要

本研究主要分別探討以「銀銅共還原法」與「銅粉無電電鍍銀法」來合成銀銅殼核粉(亦即銅粉表面包覆薄銀層),而本研究希望藉由此兩種合成方式,合成一中位粒徑小於10 μm 且具純銀導電性之微奈米銀銅殼核粉,以取代傳統成本較高之純銀粉,並提供電子業製作導電相關產品之用。

由「銀銅共還原法」之研究結果得知,當分別使用次亞磷酸鈉、抗壞血酸或異抗壞血酸鈉作為還原劑,以及控制不同之還原劑與銅銀金屬離子之莫耳比,並搭配於不同添加時間點下加入銀鹽進行粉體合成時,合成所得之粉體經由掃描式電子顯微鏡之背相散射顯像圖分析比對,顯示其不具有銀銅殼核之結構,另將該粉體製成導電塗層後經體電阻值分析後,發現該粉體不具導電性,故本研究使用之「銀銅共還原法」無法合成銀銅殼核粉。

另本研究所採用之「銅粉無電電鍍銀法」須透過兩階段進行合成銀銅殼核粉,第一階段係先透過田口法實驗設計,合成出可作為內層銅核使用之銅粉,本階段所得純銅粉之最佳合成參數包括將21.5 kg之硫酸銅與18.91 kg之磷酸鹽加入150 L之純水中,並控制反應溫度於70 $^{\circ}\text{C}$ 、攪拌轉速300 RPM,即可合成出粒徑為7.36 μm 之純銅粉。另第二階段則於此純銅粉表面上披覆上銀層,其最佳實驗參數為取2.53 g銅粉與0.08 g檸檬酸鹽加入100 ml純水中配置為銅粉分散液,另取1.17 g硫酸銀與0.065 g檸檬酸鹽配置成銀鹽溶液,於1000 RPM之轉速下,將此銀鹽溶液迅速倒入銅粉分散液中,待反應10分鐘後,即可完成銅粉無電電鍍銀程序。此最佳合成粉體經掃描電子顯微鏡與表面元素分析儀分析後,証實該合成粉體為一具有奈米銀層之銀銅殼核結構,另該粉體所製作之導電塗層經檢測,其體電阻值與純銀粉體所製作之導電塗層完全相同(1.43×10^{-4} $\Omega\cdot\text{cm}$),且該粉體經熱重分析儀分析後,可發現該粉體之氧化速率(0.1465 Wt%/min)相較純銅粉明顯趨緩(0.5745 Wt%/min)。

綜上述,本研究所研發之「銅粉無電電鍍銀法」可合成一具有純銀導電性以及良好抗氧化性之微奈米銀銅殼核粉體,由於此粉體之生產成本遠較傳統純銀粉低廉,故適合廣泛推廣應用於導電材料之使用。

關鍵詞: 共還原、無電電鍍、微奈米、田口法、銀、銅、導電、殼核

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