

磁控濺鍍AZO透明導電薄膜及其應用於染敏太陽電池之研究

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摘要

本研究以磁控濺鍍法沉積AZO透明導電薄膜，並將其應用於染敏太陽電池(DSSC)之製作。主要可以分為兩個部份，第一部份主要是探討以磁控濺鍍系統濺鍍 AZO透明導電薄膜的製程參數，利用FE-SEM、XRD、Hall-effect、UV-VIS來探究AZO薄膜之光電特性。由實驗分析結果顯示：在工作壓力為 2×10^{-3} torr、基板溫度325 °C下，濺鍍AZO薄膜有最低電阻率： 2.9401×10^{-4} Ω·cm，且其載子濃度： 3.2599×10^{21} (cm⁻³)和遷移率： 6.4682 (cm²·V⁻¹·S⁻¹)；在Ar/H₂(6%)氣氛環境下以550 °C熱退火一小時，能更進一步提升AZO電性，電阻率： 2.0176×10^{-4} Ω·cm，載子濃度： 2.7939×10^{21} (cm⁻³)，遷移率為： 11.08518 (cm²·V⁻¹·S⁻¹)。再將濺鍍好的AZO薄膜，以HCl對其進行表面粗糙化處理，利用UV-VIS、四點探針、霧度計、FE-SEM分析其光電性質，以及對薄膜做表面觀察。本論文第二部分主要將論文第一部份所沉積之AZO透明導電玻璃基板，應用在製作染料敏化太陽能電池上。以 Degussa P25 TiO₂旋塗在AZO薄膜上，使用D719做為染料，EL-100為電解液；探討AZO透明導電玻璃在經過DSSC製程後的電性變化，以及利用不同光電極燒結方式，來改善電池整體效率。由標準太陽光源模擬系統顯示，當以450 °C燒結TiO₂，且TiO₂厚度約為8.6 μm之光電極所製成的DSSC，其光伏特性為：開路電壓(Voc)=0.8383V、短路電流(Jsc)=3.118mA/cm²、填充因子(FF)=0.50、光電轉換效率(η)=1.304%。上述光電極，再經過Ar/H₂(6%)氣氛環境下以450 °C熱退火一小時，所製成之DSSC具有更佳的光伏特性，以標準太陽光源模擬系統量得之結果為：Voc=0.8519 V、Jsc=4.460 mA/cm²、FF=0.53、η=2.009%。

關鍵詞：磁控濺鍍、AZO透明導電薄膜、染料敏化太陽能電池

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