

行政院原子能委員會
委託研究計畫研究報告

大氣電漿模擬

Modeling of Atmospheric Glow Discharge

計畫編號：

受委託機關(構)：中原大學

計畫主持人：魏大欽

核研所參與人員：謝政昌、吳敏文、薛天翔

聯絡電話：03-2654124

E-mail address：tcwei@cycu.edu.tw

報告日期：中華民國九十五年十一月三十日

中文摘要

低溫電漿已廣泛應用於半導體及光電工業之薄膜沉積與蝕刻製程，然而目前業界所使用的低溫電漿均在低壓下操作，需要大型真空幫浦。因此產學界在近年來開發出能在常壓下均勻放電的低溫電漿，希望能取代目前低壓操作之電漿。本研究針對 He/O₂ 常壓輝光放電建立數學模型，以電腦模擬之方式探討製程操作參數對電漿中之主要反應物種濃度之影響，除了可明瞭常壓輝光放電之主要產生機制，亦可得知電漿物種之組成，預測其用於電漿蝕刻或表面改質製程之可行性。除建立零維電漿模型外，亦建立一維電漿模型，解析電漿中主要物種濃度隨時間的週期變化，發現常壓電漿需使用大量氬氣之主因，及氧氣添加量對電漿之影響。最後，本研究亦對電漿進行放射光譜分析(OES)，測量主要物種濃度，並與模型計算值比對。

Abstract

Cold plasma technology has been widely used in the deposition and etching process in IC and TFT LCD industry. However cold plasma is usually operated at low-pressure, thus vacuum pump is required. Recently, the Atmospheric-Pressure Glow Discharge (APGD) was developed to generate uniform plasma at one atmosphere. Although the gas temperature in APGD is low, the range of operating voltage and frequency is limited, and copious amount of Helium gas are needed to sustain APGD, otherwise the discharge becomes filamentary. In addition, the ion density and radical density distributions as a function of time are not easy to be characterized. In this study, a mathematical model for He/O₂ APGD is developed. The effects of operating parameters on the species density distributions are found by the developed model. Finally, the optical emission spectrum (OES) of He/O₂ APGD is measured and the radical density measured by OES is compared to model calculations.