奈米晶寬能隙半導體薄膜製備與應用

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摘 要

本研究係以溶膠-凝膠(sol-gel)法，製備透明導電的AZO薄膜。首先將氯化鋁添加於醋酸鋅水溶液中，經旋轉塗佈(spin-on-deposition)於玻璃基板上。其中調控Al之?雜濃度、熱處理、二次熱處理添加還原氣體，依此，分析AZO薄膜之結構、電性及其光學特性。 本研究經SEM分析發現AZO薄膜之晶粒小於10nm，係屬同質性，緻密細微構造。又摻雜濃度之調控可提升光學特性及電性，常壓下熱處理、二次熱處理添加還原氣體，促使薄膜有良好結晶性。 本研究最理想的摻雜濃度為 Al/Zn=2.25 at.%，最小電阻率為9.90×10-3 歐姆-cm，?子濃度和遷移率分別是1.25×1020cm-3 and 5.04 cm2V-1S-1，可見光區之透光率可達90%以上。 接下來本研究分別以紫外光和可見光照射於塗有二氧化鈦光觸媒之管狀反應裝置中，分析光催化分解低濃度甲苯之特性。 本研究所使用之二氧化鈦光觸媒有，SG-TiO2和P25-TiO2二種型式。全部的光觸媒以浸鍍法塗佈在玻璃管內部表面，接下來作熱處理。另使用二氧化鈦及TCPP分別調製出TCPP/SG-TiO2 與 TCPP/P25-TiO2之二氧化鈦光觸媒，使其具光敏性，再以可見光方式進行照射。進行4種光觸媒對於低濃度甲苯進行光催化分解分析。經紫外光方式進行照射之兩種TiO2光觸媒薄膜皆能有效分解低濃度甲苯[To]，然而當甲苯濃度分別從原始狀態增加至6.5 ppm 及4.0ppm時，SG-TiO2及，P25-TiO2光觸媒對甲苯分解力明顯下降。甲苯EC圖顯示SG-TiO2 及P25-TiO2 之EC 分別為 4.9 和2.7 mg hr-1 m-2。在相同的條件比較下可見光及紫外光對染料敏化TiO2光觸媒照射下，可見光對甲苯分解力低於紫外光。在相同的條件下，TCPP/P25-TiO2光觸媒經HCl溶液浸泡酸處理後，對甲苯分解力有進一步的改善。在我們的研究光觸媒分解低濃度甲苯之動力學時，一般應符合Langumuir-Hinshelwood (L-H)模式，k為L-H模式之比例常數，而K為吸收常數兩者成反比趨勢， SG-TiO2 分解甲苯能力比P25-TiO2大，因此，SG-TiO2光觸媒對甲苯有較高的分解力，經XRD分析銳鈦礦之結晶，歸因於有較小的grain size (4.6~8.1 nm)。

關鍵詞 : 鋁?雜氧化鋅（AZO）、薄膜、化學先驅物、水相沉積、室內空氣、光觸媒、染料敏化二氧化鈦、甲苯、可見光.

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