行政院原子能委員會

委託研究計畫研究報告

銦鉭氧化物光觸媒於水分解製氫反應

Preparation of In-Ta Photocatalysts for Water Splitting

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中文摘要

近年來，許多的光觸媒材料受到一些學者們的討論與研究。本研究之目的，主要在探討 Z－scheme 雙光子觸媒系統與鈉坦氧化物在光照下對於水的分解活性。而雙分子光觸媒分為產氫觸媒與產氧觸媒兩個部份，根據文獻，以固態反應合成法(solid state reaction method)製備的產氫觸媒為 $Pt/SrTiO_3$：Rh，而產氧觸媒則有兩種製備方法分別為 $BiVO_4$(1)與 $BiVO_4$ (2)。我們將($Pt/SrTiO_3$：Rh)- ($BiVO_4$) 系統置於 $FeCl_3$ 水溶液中，以建立 Z－scheme 雙分子光觸媒系統，並討論在可見光及紫外光照射下對於水分解的反應活性。由實驗結果發現不論是在可見光或是紫外光下($Pt/SrTiO_3$：Rh)- ($BiVO_4$) (2)皆具有較好的活性表現。

以 InTaO4 及 BiVO4(2)做水分解反應，在紫外光下其活性僅為 Pt/SrTiO3:Rh 的 1/5，在可見光下其活性僅為 Pt/SrTiO3:Rh 的 1/10，因此其並非良好的 Z-scheme 反應之產氫觸媒。

不同的觸媒製備方法明顯影響觸媒的晶相與水分解活性。觸媒的物化特性，以下列方法鑑定：X-ray 繞射，掃描式電子顯微鏡 SEM 及紫外可見光吸收光譜儀 (UV-Vis)。觀察 SEM 圖，$Pt/SrTiO_3$：Rh 具有良好的晶相，而 $BiVO_4$(1)與 $BiVO_4$ (2)相較之下，$BiVO_4$ (2)的晶體表面顆粒較勻稱並具分散性，推論是造成水分解活性較好的原因。

關鍵字：光觸媒;雙分子光觸媒系統;水分解

Abstract

A Z-scheme system to photocatalytic dissociation og water to form hydrogen and oxygen was developed. The catalysts to produce hydrogen and oxygen were added in the aqueous solution which contains Fe^{2+}/Fe^{3+} redox couple as electron relay. The two photon catalyst Z-scheme system can split water into H_2 and O_2 under visible light irradiation. The aim of this study was to develop an efficient system for water splitting under visible light irradiation.

Different preparation method of catalysts influenced their crystal structure and their activities for water splitting. The characteristics of the catalysts were carried out by using X-ray powder diffration, scanning electron microscopy (SEM) and UV-Vis. SEM results show that the particle diameters of Pt/SrTiO3: Rh were about 1.5 μm. The particles of $BiVO_4$(2) is smaller, infering that the particles on the surface might influence the activity of photocatalyst.

The two-photon catalyst Z-scheme system contains two parts, the H_2-photocatalyst and the O_2-photocatalyst. The H_2-photocatalyst catalyst SrTiO3 was prepared by using solid state reaction method. The O_2-photocatalyst BiVO4 was prepared by two methods. To construct a Z-scheme system, ($Pt/SrTiO_3$:Rh)-($BiVO_4$)(1) and

($Pt/SrTiO_3$:Rh)-($BiVO_4$)(2) was added into the ferric chloride aqueous respectively, and irradiated under visible light or ultraviolet light. The results indicated that ($Pt/SrTiO_3$:Rh)-($BiVO_4$)(2) is more active, no matter under visible light or ultraviolet light illuminating.

Keywords：photocatalyst; Z-scheme system; water splitting, hydrogen, oxygen, solar energy.