摘要

多層次的二氧化鈦/二氧化釩奈米柱複合結構被合成出來：利用射頻濺鍍在矽基材上長出二氧化釩奈米柱，接這在其上用旋轉塗佈法塗佈無晶相的二氧化鈦層，在乙酸液熱反應底下，這層無晶相層會轉變成特殊形貌的鈦酸鹽類，再經過 700 ^{o}C 持溫 1 小時的退火動作，鈦酸鹽類會轉變成 anatase 相的二氧化鈦，並且不改變形貌。我們可以得到亞微米顆粒、花狀和奈米顆粒三種不同形貌的二氧化鈦。

不同型貌的多層次二氧化鈦/二氧化釩奈米柱複合結構可以當作在光電化學水分解的光陽極，所使用的電解液為 1 M KOH，在氙燈照射下，電壓 0.2 V vs.Ag/AgCl 時，花狀二氧化鈦可以測到的光電流增益為 2.20 mA/cm^2，二氧化鈦奈米顆粒可測到 1.16 mA/cm^2，二氧化鈦亞微米顆粒可測到 1.48 mA/cm^2。

但是，量測不同厚度的花狀二氧化鈦二氧化釩奈米柱複合結構的光電流增益，當厚度大於 6 μm，光電流增益和穩定性會有明顯的下降，因此我們推測最佳厚度可能在 2 μm 附近，花狀二氧化鈦在三個形貌中表現最好。在光電化學水分解中，多層次二氧化鈦/二氧化釩奈米柱是依很有潛力的光陽極。

關鍵字：光電化學、水分解、二氧化鈦、二氧化釩、奈米柱、多層次結構

Abstract

Hierarchical TiO_2 / RuO_2 nanorod heterostructure was synthesized. Amorphous TiO_2 layer was firstly spin-coated onto RuO_2 nanorods on Si wafer prepared by RF sputtering. The amorphous layer was transformed to titanate with special morphology under acetic acid solvothermal reaction. After heating at 700 ^{o}C for 1 h, the titanate further transfer to anatase without morphology change. Three kinds of morphology of TiO_2 were synthesized, including submicron-particle, flower-like, and nanoparticles.

Furthermore, the varied-morphologied TiO_2 / RuO_2 nanorods heterostructure was used as working electrode for photoelectrochemical water splitting in 1 M KOH aqueous solution. It showed larger photocurrent enhancement (2.20 mA/cm^2 at 0.2 V vs Ag/AgCl) compared with that of TiO_2 nanoparticles / RuO_2 nanorods (1.16 mA/cm^2 at 0.2 V vs Ag/AgCl) and that of TiO_2 submicron-particles (1.48 mA/cm^2 at 0.2 V vs Ag/AgCl) under the irradiation of a Xe lamp.

However, the photocurrent enhancement and photostability of TiO_2 / RuO_2 nanorod heterostructure with varied thickness drop largely when the thickness of the sample exceeds 6 μm. From the outcome above, the optimum thickness is around 2 μm, and the performance of flower-like TiO_2 is the best among the three morphologies. These suggest the hierarchical heterostructure that TiO_2 flower / RuO_2 nanorods can be employed as a potential photoanode for photoelectrochemical water splitting.

Keywords：photoelectrochemical, water splitting, titanium dioxides, ruthenium dioxides, nanorods, hierarchical structure