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微/纳米多孔氧化锌薄膜的电化学制备及其光催化性能

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摘 要: 在高度阴极极化条件下, 以析氢气泡为动态模板, 电沉积制备微/纳米多孔锌薄膜, 经加热氧化制备得到微/纳米多孔氧化锌薄膜。研究电流密度、镀液组成和温度对多孔金属锌薄膜孔径大小和孔壁形貌的影响。结果表明: 通过改变电流密度、镀液组成和温度, 可调控孔径大小和孔壁结构; 在30 °C的0.05 mol/L ZnSO₄和2 mol/L NH₄Cl溶液中, 电流密度为0.3-0.8 A/cm²时, 可得到主孔径约为50-100 μm的多孔锌薄膜, 形成孔壁的枝晶由大小为100-300 nm的颗粒构成; 在空气气氛下经350 °C加热1 h、450 °C加热2 h氧化处理后, 多孔锌薄膜转变为具有相似微/纳米多孔结构的氧化锌薄膜, 并显示出优异的光催化降解罗丹明B的性能。

关键字: 微/纳米结构; 多孔薄膜; 氧化锌; 光催化

Electrochemical preparation of micro/nano-structured porous ZnO films and their photocatalytic activity

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Abstract: Micro/nano-structured porous ZnO films were obtained by heating porous Zn films electrodeposited using hydrogen bubbles as templates at higher cathodic polarization. The influence of deposition parameters, including current density, concentration of ZnSO₄ and NH₄Cl, and temperature of the electrolyte on the morphologies and structures of the porous Zn films was systematically studied. The results show that the size of the pores and the morphologies of the pore walls can be easily tuned by controlling the electrodeposition parameters. The Zn films with the major pores of 50-100 μm and dendritic crystallines made up of particles with 100-300 nm in the pore walls can be obtained in the solution of pH 5

containing 0.05 mol/L ZnSO₄, 2.0 mol/L NH₄Cl at 30 °C and current densities of 0.3–0.8 A/cm². The micro/nano-structured porous ZnO films are prepared by heating the porous Zn films in air at 350 °C for 1 h following by at 450 °C for 2 h. And the better photocatalytic activity for photocatalytic degradation of rhodamine B is demonstrated.

Key words: micro/nano structure; porous films; zinc oxide; photocatalysis

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