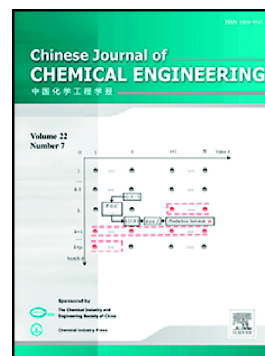


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Article

Controlling dispersion and morphology of MoS₂ nanospheres by hydrothermal method using SiO₂ as template[#]

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Abstract Monodispersed MoS₂ nanospheres were successfully synthesized by using SiO₂ as hard template. The size and morphology of the MoS₂ nanospheres could be finely controlled by the content of SiO₂ and sulfur precursors. Furthermore, higher surface area of monodispersed MoS₂ nanospheres exhibited high reaction rate for hydrodesulfurization (HDS) of Dibenzothiophene(DBT).

Keywords: Molybdenum disulfide; Hard template; Monodisperse; hydrodesulfurization

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1 Introduction

Molybdenum disulfide (MoS₂) is a transition metal chalcogenide material widely used in photocatalysis [1], synthesis catalyst [2], hydrodesulfurization [3], hydrodeoxygenation [4]. Two-dimensional MoS₂ is widely used in electronic [5], optical [6], mechanical [7], even in hydrogen evolution reaction (HER) [8]. Morphology and particle size of MoS₂ can obviously influence their chemical and physical properties, but possessing controllable morphology and dispersion of MoS₂ nanocrystal still remain big challenges. A variety of methods to controllably synthesize MoS₂ nanomaterials with different shape have been reported using different precursors and reaction conditions. Early method was sulfidation of molybdenum oxides MoO₃ by sulfur compounds (KSCN [9], Na₂S [10], sulfur powder [11]) in a stainless steel autoclave under a suitable temperature to obtain MoS₂ with high crystallinity but their surface area was only < 100 m²·g⁻¹. Other precursors such as Mo(CO) [12], MoCl₅ [13] in the reaction decomposed quickly and uncontrollable. (NH₄)₂MoS₄ is a new precursor, which can decompose easily in reducing gas or solvent, and form MoS₂ with high crystallinity, but morphology of MoS₂ cannot be also controlled well. Recently, template method is probably the most effective and general route to prepare nanostructures and can be used to controllably adjust morphology of MoS₂. MoS₂ nanospheres were synthesized by using Pluronic P-123 and other surfactants, unfortunately, surface area was lower than 140 m²·g⁻¹ and these organic compounds interact with MoS₂ removing difficultly. MoS₂ nanotubes, nanorods, nanospheres were successfully prepared by using hard templates such as: mesoporous Al₂O₃ [14], MoO₃ nanorods [15] and carbon nanospheres [16]. However, size of these MoS₂ nanomaterials was difficult to control and the rigid templates were hard to remove completely. Skrabalak *et al.* [17] reported that mesoporous MoS₂ with a narrow pore size distribution and high surface area of 200 m²·g⁻¹ used SiO₂ nanoparticles as hard templates was synthesized successfully and the SiO₂ template can be

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