

Thongthai Witoon 2010: Synthesis of Bimodal Porous Silica from Rice Husk Ash Using Chitosan as Template and the Application as Catalyst Support for Fischer-Tropsch Synthesis. Doctor of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Associate Professor Metta Chareonpanich, D.Eng. 111 pages.

Bimodal porous materials with different pore sizes exhibit several applications including catalysis, adsorption, and selective separation due to the fact that their small pores can interact with reactant molecules whereas large pores provide high-speed pathways for the transport of gas and liquid molecules. In this work, the bimodal porous silicas were synthesized via the sol-gel technique using rice husk ash as a silica source and chitosan as a template. The studied variables were pH of mixture, chitosan/silica ratio, and aging temperature. It was found that the largest amount of chitosan was incorporated into the silica network at pH value of 6 due to the strong interaction between positively charged amino groups of chitosan and negatively charged silica oligomers. The silica cluster size could be controlled by manipulating the chitosan/silica ratio through the silica entrapment within the voids of chitosan networks. After chitosan removal, macropores were formed by the aggregates of small silica cluster size (100-200 nm). The different morphologies of bimodal porous silica products including interconnected and particle aggregated structures were also observed with the change of aging temperatures. The obtained bimodal porous silicas were used as the support of cobalt catalysts and tested for the performance of Fischer-Tropsch synthesis reaction. The obtained data was compared to those of monomodal porous silica supports. It was found that the cobalt-loaded monomodal porous silica gave higher CO conversion within 8 h on stream. After that, the CO conversion was drastically decreased because of the deposition of heavy hydrocarbons and the oxidation of cobalt active phase ( $\text{Co}^0$ ) to inactive phase ( $\text{CoO}$ ). The coke deposition could be accelerated by the very long pore length of monomodal porous silica supports. For bimodal porous silicas, the pore length of was significantly short, thus the heavy hydrocarbons could be easily penetrated from the catalyst pores. As a result, CO conversion with more stability and higher  $\text{C}_{5+}$  selectivity were obtained with cobalt-loaded bimodal porous silica supports.

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