Atomic Layer Deposition of MoO₃ on Mesoporous γ-Al₂O₃ Prepared by Sol-Gel Method as Efficient Catalyst for Oxidative Desulfurization of Refractory Dibenzothiophene Compound

Authors : S. Said, Asmaa A. Abdulrahman

Abstract : MoO_x/Al_2O_3 based catalyst has long been widely used as an active catalyst in oxidative desulfurization reaction due to its high stability under severe reaction conditions and high resistance to sulfur poisoning. In this context, 4 & 9wt.% MoO_3 grafted on mesoporous γ -Al₂O₃ has been synthesized using the modified atomic layer deposition (ALD) method. Another MoO_3/Al_2O_3 sample was prepared by the conventional wetness impregnation (IM) method, for comparison. The effect of the preparation methods on the metal-support interaction was evaluated using different characterization techniques, including X-ray diffraction, X-ray photoelectron spectroscopy (XPS), N₂-physisorption, transmission electron microscopy (TEM), H₂-temperature-programmed reduction and FT-IR. Oxidative desulfurization (ODS) reaction of the model fuel oil was used as a probe reaction to examine the catalytic efficiency of the prepared catalysts. ALD method led to samples with much better physicochemical properties than those of the prepared one via the impregnation method. However, the 9 wt.% MoO_3/Al_2O_3 (ALD) catalyst in the ODS reaction of model fuel oil shows enhanced catalytic performance with ~90%, which has been attributed to the more Mo^{6+} surface concentrations relative to Al^{3+} with large pore diameter and surface area. The kinetic study shows that the ODS of DBT follows a pseudo first-order rate reaction.

Keywords : mesoporous Al₂O₃, xMoO₃/Al₂O₃, atomic layer deposition, wetness impregnation, ODS, DBT

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