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Investigation of Sulfur Behavior on Mo-based Hydrodesulfurization Catalysts Supported on High Surface Area TiO_2 by ^{35}S Radioisotope Tracer Method

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Mo catalysts were prepared by impregnation of titania synthesized by the pH swing method which provides a TiO_2 carrier with a high specific surface area (134 $m^2 \cdot g^{-1}$) and excellent mechanical properties. Dibenzothiophene (DBT) hydrodesulfurization (HDS) activity was estimated over the obtained catalysts under typical HDS reaction conditions for various Mo contents. The activity increased linearly with Mo content up to *ca*. 16 wt% MoO_3 and then decreased for higher Mo loadings. The sulfur behavior on the sulfided Mo/TiO_2 catalysts was elucidated under the reaction working conditions using a ^{35}S radioisotope tracer method, or the HDS of ^{35}S-labeled DBT. The results indicated that at a given temperature the H_2S release rate constant (k_{RE}) was almost constant irrespective of the Mo content, and the amount of labile sulfur (S_0) increased linearly with the Mo content in parallel with the activity up to *ca*. 16 wt% MoO_3. The optimal Mo dispersion was 5.2 atom/nm^2, which is higher than the optimal Mo dispersion on 70 $m^2 \cdot g^{-1}$ TiO_2 (4.2 atom/nm^2). Comparison of k_{RE} and S_0 of the titania-based catalysts and the alumina-based catalysts suggested that the active phase consists of a 'TiMoS' phase exhibiting a promoting effect similar to the

well-known 'CoMoS' phase (promotion of the MoS_2 active phase by Ti atoms).

Keywords: Hydrodesulfurization, High surface area titania, Molybdenum catalyst, Radioactive tracer method

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