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THE INCREASED PROMOTION IN COBALT-MOLYBDENUM
HYDRODESULFURIZATION CATALYSTS SUPPORTED ON ALUMINA,
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NITRILOTRIACETIC ACID

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Increasingly stringent regulations on sulfur level in liquid fuels drive the research on highly active hydrodesulfurization (HDS) catalysts. The conventional CoMo catalysts are supported onto $\gamma\text{-Al}_2\text{O}_3$ and they are mostly prepared by consecutive deposition of ammonium heptamolybdate and cobalt nitrate followed by calcination and sulfidation. Alternatively, chelating agent such as nitrilotriacetic acid (NTA) is employed during the preparation to increase the HDS activity. In the present paper, a new method based on impregnation of unconventional supports (i.e. activated carbon and ZrO_2) by the NTA assisted spreading of molybdenum trioxide with cobalt carbonate, or ammonium heptamolybdate with cobalt carbonate was investigated. The selected prepared catalysts were characterized by X-ray diffraction, N_2 physisorption, O_2 chemisorption and activity in HDS reaction in the gas phase of thiophene (TH) at 1.0 MPa and 400 °C or 1-benzothiophene (BT) at 1.6 MPa and 360 °C. The promotion effect of Co was expressed as ratio of activity of CoMo catalyst and its Mo counterpart. It was found that NTA dissolved the low soluble precursors (MoO_3 with CoCO_3 or the mixture of ammonium heptamolybdate with CoCO_3) at NTA/(Co+Mo) molar ratio of 0.3-1.0/1.0, which allowed the deposition of the compounds onto the supports by impregnation. The support effect was ascertained to be the main factor governing the activity of Mo and CoMo catalysts. The carbon supported Mo and CoMo catalysts exhibited more than 2 times higher HDS activities than their Al_2O_3 and ZrO_2 supported counterparts. The employing of the chelating agent nitrilotriacetic acid in the preparation of the CoMo catalysts supported on $\gamma\text{-Al}_2\text{O}_3$, activated carbon, and monoclinic- ZrO_2 systematically increased the promotion effect of Co in hydrodesulfurization reaction of thiophene and benzothiophene at high pressure by the factor 1.13-1.58. The most active CoMo/ Al_2O_3 , C and ZrO_2 catalysts in benzothiophene HDS were prepared by the impregnation of the support from the solution made by dissolution of MoO_3 , CoCO_3 and nitrilotriacetic acid in water followed by sulfidation without previous calcination. The optimal molar ratio NTA/(Co+Mo) to achieve high hydrodesulfurization activities was 1/1. Authors gratefully acknowledge the Albemarle Company (The Netherlands) and the BASF Company (Germany) for providing reference catalysts and the Czech Science Foundation (grant number P106/11/0902) for the financial support.

References:

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