Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

Effect of Direct Synthesis Al-SBA-15 Supports on the Morphology and Catalytic Activity of NiMoS Phase in HDS of DBT

Shujiao Jiang, Yasong Zhou, Qiang Wei, Sijia Ding, Wenwu Zhou, Yacheng Shan*

State Key Laboratory of Heavy Oil Processing, China University of Petroleum, Beijing 102249, PR China

***Corresponding Author**

Phone: 0086 010 89733501.

E-mail: zhouyasong2011@163.com.

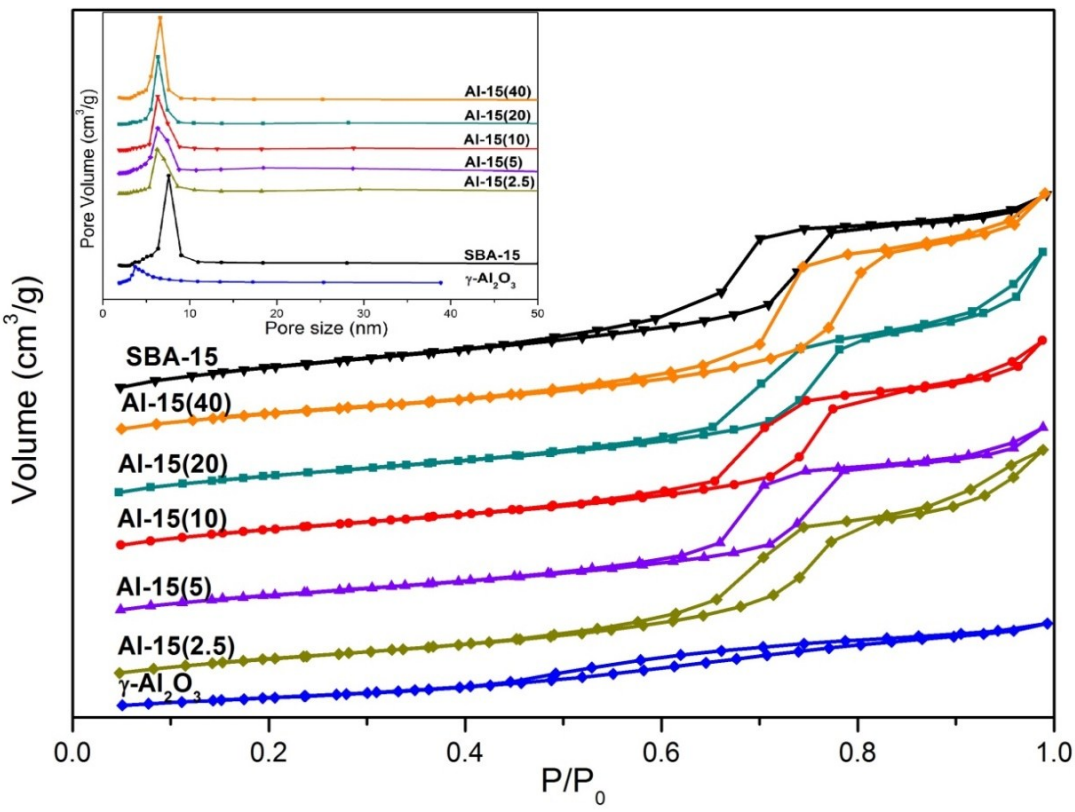
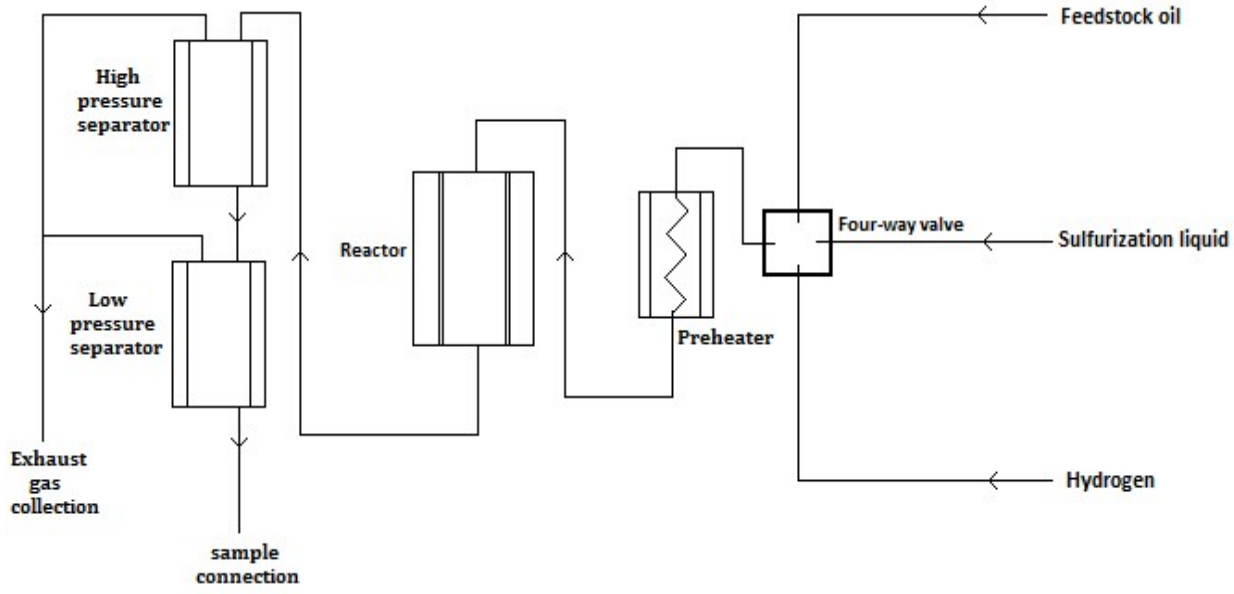


Fig. S+1 Nitrogen adsorption-desorption isotherms and pore size distribution curves of supports.



Scheme1. Reaction process diagram of hydrotreating.

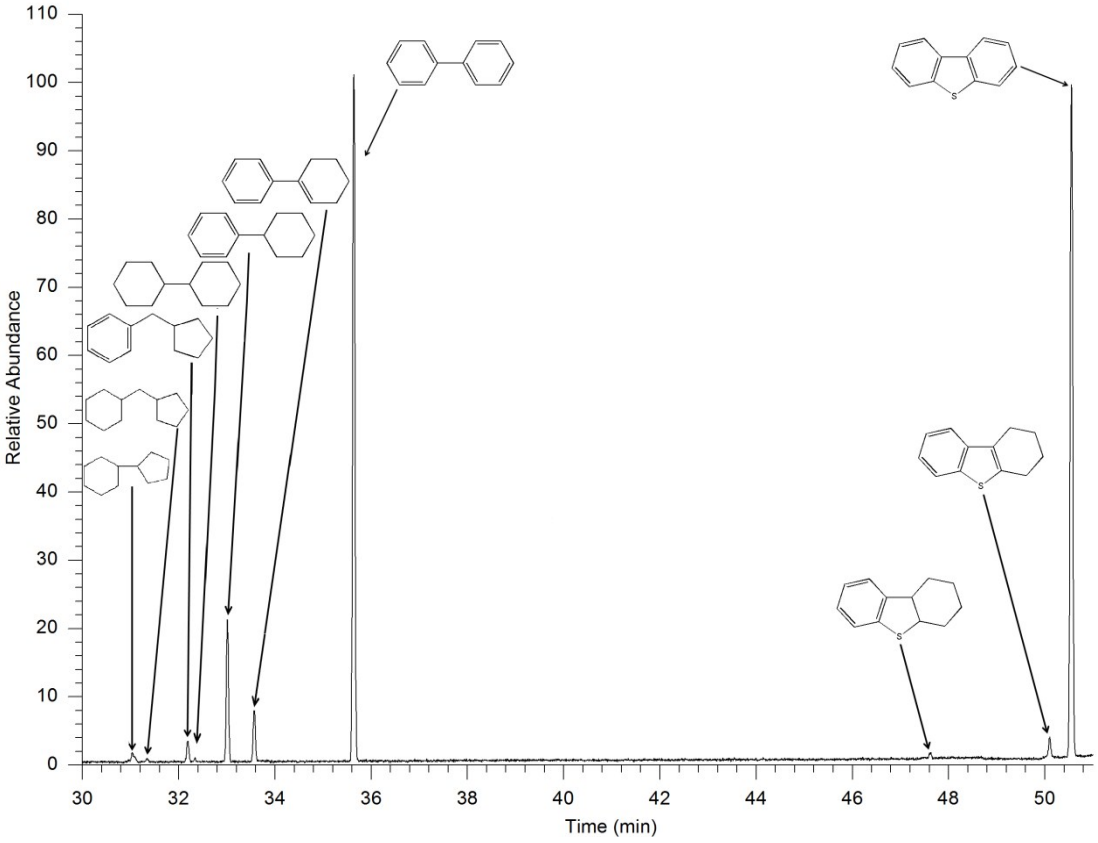


Fig. S+2 GC chromatograph of DBT HDS products over NiMo/Al-15(10) catalyst at 270 °C.

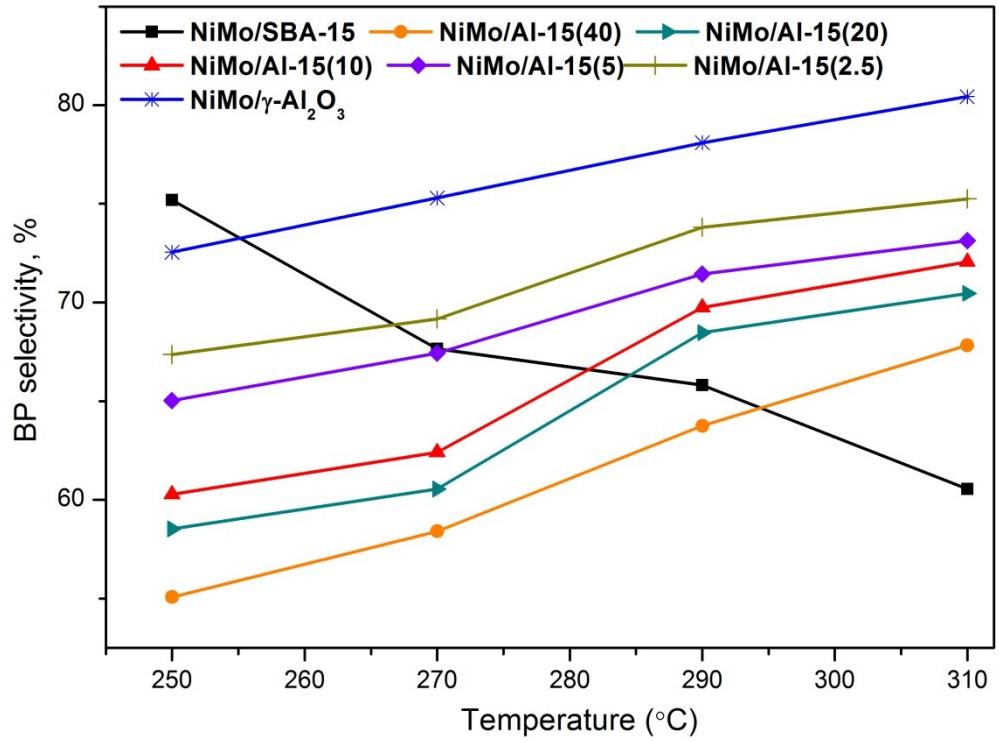


Fig. S+3 BP selectivity at different temperatures over supported NiMo catalysts with 10.53 h^{-1} of LHSV.

It has been verified that the HYD route of sulfur-containing compounds was thermodynamically limited at high temperature, therefore, the selectivity of BP increase with temperature except over NiMo/SBA-15.[1] The active phase distribution and DBT HDS conversion over NiMo/SBA-15 has a big gap with other catalysts. The BP selectivity changed under the different temperatures, it could be predicted that there are obvious activation energy difference between DDS and HYD. And the BP selectivity over NiMoS/SBA-15 becomes lower than Al promoted catalysts when the temperature increased to 290°C.

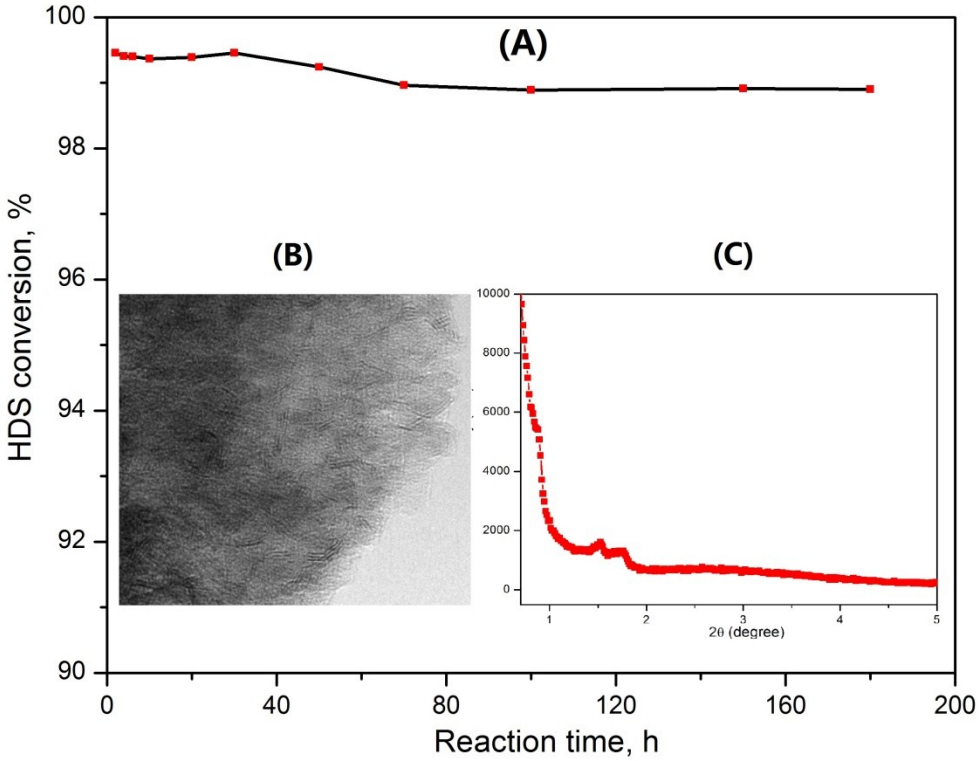


Fig. S+4 The conversion of HDS with the time over NiMo/Al-15(10) catalyst (A), HRTEM image (B) and small-angle XRD pattern (C) of NiMo/Al-15(10) catalyst after stability test.

The stability test of NiMo/Al-15(10) was performed at 330 °C, 4 MPa and 180 NL/L for 180 h. There are less 10 ppm S compounds left after 180 reaction hours and HRTEM image still presents fine dispersion of NiMoS phases, indicating the excellent activity and stability of NiMo/Al-15(10) catalyst during HDS processes. In addition, the small-angle XRD result presents the hydrothermal stability of Al-15(10) support.

1. D. Gao, A. Duan, X. Zhang, Z. Zhao, H. E, J. Li and H. Wang, *Appl. Catal., B*, 2015, **165**, 269-284.