SYNTHESIS OF ZSM-5 BASED MESOSTRUCTURES AND FUNCTIONALIZATION WITH NI NPS FOR ADSORPTIVE DESULFURIZATION

[1]FAZLE SUBHAN, [2]SOBIA ASLAM, [3]ZIFENG YAN

[1,2,3]State Key Laboratory of Heavy Oil Processing,ChinaUniversity of Petroleum,Qingdao 266580, China
[1,2]Department of Chemistry, Abdul Wali Khan University Mardan, K.P, Pakistan
E-mail - [1]fazle@awkum.edu.pk, [3]zfyancat@upc.edu.cn

Abstract - Adsorptive desulfurization of commercial fuels is highly influence by diffusion restrictions in mesoporous materials because of the greater kinetic dimensions of sulfur compounds and aromatics. In this contribution toward the relevant field, we explored that metal based hierarchically ZSM-5-based mesostructures (MMZ) can reduce overcome such scarcities without compromising the desulfurization activity. The mesopores of MMZ reduces path length for diffusion to the zeolite internal sites, and the metals (here, Ni) not only establish strong interactions but also enhances the adsorption configurations. The MMZ was synthesized by subjecting commercial H form ZSM-5 (SiO_2/Al_2O_3= 28) via sequential dissolution-self-assembly and doped with Ni via ultrasound-assisted impregnation. The samples were characterized by N_2 sorption, NH_3-TPD, XRD, H_2-TPR TEM, SEM, FT-IR, elemental distribution mapping, and XPS techniques. The results revealed that high surface area up to 831 $m^2.g^{-1}$ and well-ordered mesostructures obtained when ZSM-5 was subjected to dissolution in 1.0 $mol.L^{-1}$ NaOH solution and re-assemblyof Al- or Si-containing species usingcetyltrimethylammonium bromide (CTAB) as a template. The sulfur adsorption capacity was improved from 4.8 to 14.1 mg/g after Ni species and up to 10 wt% are highly dispersed over MMZ. The adsorption capacities of samples decrease in the following order 10Ni/MMZ > 5Ni/MMZ >15Ni/MMZ >MMZ and the increased performance may be ascribed to increased surface acidity, well distributed Ni NPs and texture of MMZ. The isotherm data of thiophene adsorption were fitted well by Langmuir isotherm while kinetic study described that the adsorption data followed pseudo-second order model.

Graphical Abstract:

