

## Supporting information

### **Phosphotungstic acid on zirconia-modified silica as catalysts for oxidative desulfurization**

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**Table S1. Textural properties and HPW/ZrO<sub>2</sub>-SiO<sub>2</sub> content of samples**

catalyst	Surface area (m <sup>2</sup> /g)	Pore volume(cm <sup>3</sup> /g)	Pore size (nm)
SiO <sub>2</sub>	298.5	0.19	2.59
ZrO <sub>2</sub> -SiO <sub>2</sub>	278.0	0.19	2.71
HPW-SiO <sub>2</sub>	283.16	0.18	2.47
HPW/ZrO <sub>2</sub> -SiO <sub>2</sub>	223.82	0.16	2.77

**Table S2. The FT-IR bands observed for prepared materials. All the bands were assigned based on the literature.**

<b>Material</b>	<b>Bands, <math>\nu(\text{cm}^{-1})</math></b>
<b>SiO<sub>2</sub></b>	broad -3500 (hydrogen bonded OH), intensive broad band at 1100–1225 (stretching of siloxanes Si–O–Si), 967 (free silanols Si–OH stretching), 800 (Si–O bending), 460 (Si–O out of plane deformation),
<b>ZrO<sub>2</sub>/ SiO<sub>2</sub></b>	broad -3500 (hydrogen bonded OH), broad -3000 (C–H symmetric and asymmetric stretching modes of butoxy groups), diminished (almost disappeared) at 967 (stretching of Si–O–Si or/and Si–O–Zr)
<b>HPW- SiO<sub>2</sub></b>	broad -3500 (hydrogen bonded OH), 967 (free silanols Si–OH stretching), 800 (Si–O bending), 460 (Si–O out of plane deformation), 1065 ( $\nu_{\text{asP-O}}$ , from the subtracted spectrum), 989 (W–O <sub>d</sub> asymmetric ligand vibration, terminal O bonded to W atom), 876 (interligand W–O <sub>b</sub> –W, edge-sharing O connected to W)
<b>HPW- ZrO<sub>2</sub>/ SiO<sub>2</sub></b>	broad -3500 (hydrogen bonded OH), the band for C–H stretching (-3000) disappeared indicating the complete hydrolysis of the butoxy groups, 1065 ( $\nu_{\text{asP-O}}$ , from the subtracted spectrum), 989 (W–O <sub>d</sub> asymmetric ligand vibration, terminal O bonded to W atom), 876 (interligand W–O <sub>b</sub> –W, edge-sharing O connected to W)