Submitted to the New J. Chem.

Supporting Information

Synthesis Ni(II)-phosphotungstic acid/nanocrystalline HZSM-5 catalysts for ultra clean gasoline by single-stage reactor

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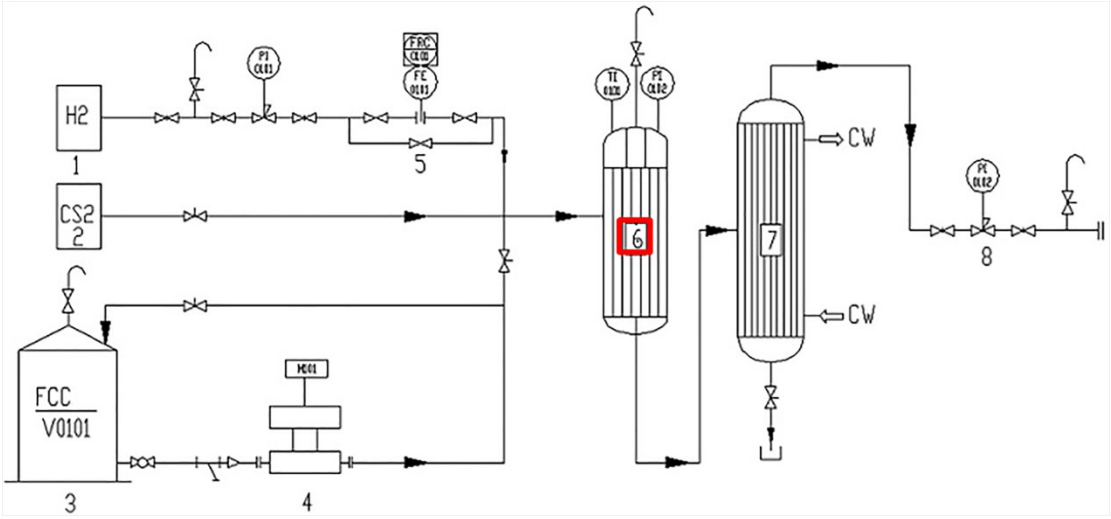

1 Hydrogen cylinder 2 Micropump 3 Raw material storage tank 4 Raw material micro pump 5 Gas mass flowmeter 6 Reactor 7 Vapor liquid separator 8 Pressure regulator

Fig. S1 Flow chart of experimental device.

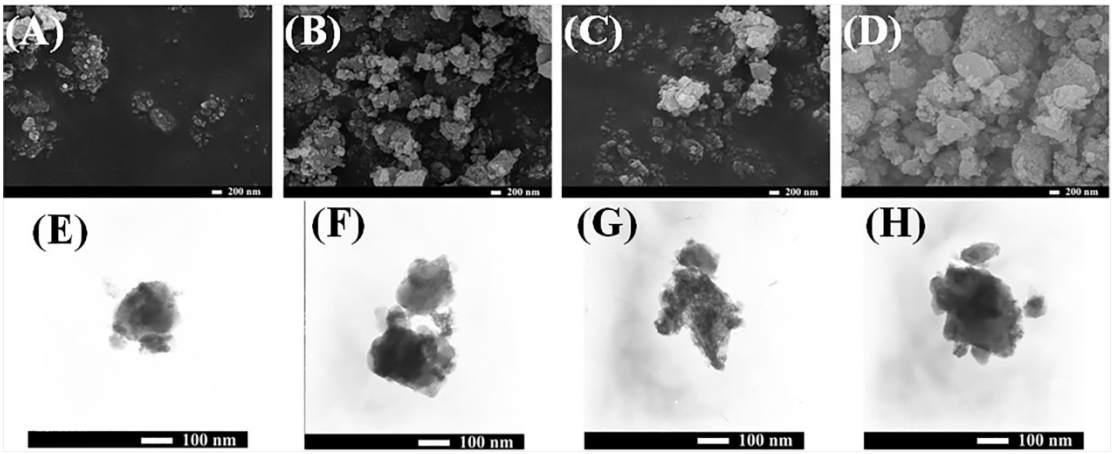

Fig. S2　SEM images of (A) Ni-Nano-Z, (B) HPW-Nano-Z, (C) La-NiPW-Nano-Z, (D) Ni-P-W-Nano-Z. and TEM images of (E) Ni-Nano-Z, (F) HPW-Nano-Z, (G) La-NiPW-Nano-Z，　(H) Ni-P-W-Nano-Z.

Table S1 IR spectra of catalysts(cm^{-1})

	Nano-Z	Ni-Nano-Z	HPW-Nano-Z	NiPW-Nano-Z	La-NiPW-Nano-Z	Ni-P-W-Nano-Z
Si−O−Al	960	960	960	960	960	960
P−Oa	−	−	1082	1063	1101	1082
W−Od	−	−	989	990	−	990
W−Ob−W	−	−	893	893	−	893
W−Oc−W	−	−	799	799	799	805

Table S2 The acid type distribution of different catalysts

	Lewis acid (1451 cm^{-1})/cm^2/g	Brønsted acid (1547 cm^{-1})/cm^2/g	B/(B+L)
Ni-Nano-Z	246.3	58.5	0.19
NiPW-Nano-Z	46.3	86.6	0.65
La-NiPW-Nano-Z	121.4	5.60	0.04
Ni-P-W-Nano-Z	183.6	78.5	0.30
HPW-Nano-Z	34.6	128.5	0.79

All acid site are provided in cm^2/g , $\varepsilon L/\varepsilon B = 0.084 /0.059$

Table S3 Adsorption capacity of different catalysts for organic sulfur compounds (mmol/g)

Catalyst	TH	BT
Nano-Z	0.057	0.012
Ni-Nano-Z	0.337	0.110
HPW-Nano-Z	0.024	0.067
NiPW-Nano-Z	0.021	0.070
La-NiPW-Nano-Z	0.058	0.109
Ni-P-W-Nano-Z	0.068	0.028

Test process:

Weigh 0.04 g catalyst, put it into 2.0 ml of prepared 200 μg/g thiophene/ benzothiophene n-octane solution, stand for adsorption for 3 h, measure the sulfur content in solution before and after reaction by chromatography. Analysis conditions: FID detection, PONA capillary column (0.25 μm×0.25 mm×50 m), vaporization chamber temperature 280 °C, detector temperature 280 °C, column temperature 150 °C ~ 250 °C. Then, adsorption capacity of different catalysts is calculated according to the following formula:

$$\Gamma = \frac{n_0}{m}\left(1-\frac{A}{A_0}\right)$$

Γ: Adsorption capacity

n_0: The number of moles of adsorbate before adsorption

m: Adsorbent quality

A: Chromatographic peak area of adsorbate before adsorption

A_0: Chromatographic peak area of adsorbate after adsorption