Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A


# Superhydrophilic mesoporous sulfonated melamine-formaldehyde resins supported palladium nanoparticles as an efficient catalyst for biofuel upgrade

Zhongfei Lv,[a] Qi Sun,[a] Xiangju Meng*[a] and Feng-Shou Xiao *[a,b]

**Supplementary Tables.**

**Table S1** Textural parameters of various samples.

| Sample | BET ($m^2/g$) | BJH pore size (nm) | Pore volume ($m^3/g$) | Micropore BET area ($m^2/g$) |
|---|---|---|---|---|
| MSMF | 256 | 10.2 | 0.50 | 20 |
| Pd/MSMF | 197 | 11.2 | 0.42 | 26 |
| Pd/MMF | 188 | ---- | 0.74 | 16 |
| $Pd/TiO_2$ | 5.6 | ---- | ---- | ---- |
| $Pd/Al_2O_3$ | 158 | 3.8 | 0.52 | 24 |
| Pd/C | 1062 | ---- | 0.72 | 185 |

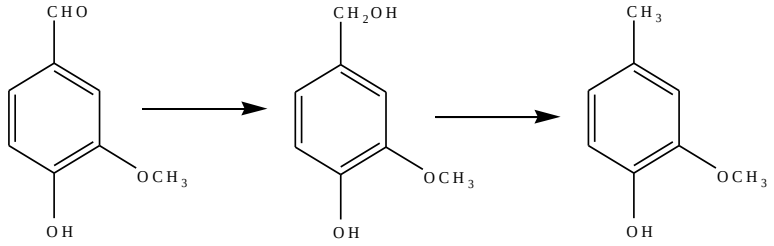
**Table S2** Molar ratio of C/H/N/S of MSMF by elemental analysis.

| Element | C | H | N | S |
|---|---|---|---|---|
| Molar ratio | 1.00 | 2.13 | 1.16 | 0.12 |

**Table S3** Molar ratio of C/N/O/S of MSMF by XPS analysis.

| Element | C | N | O | S |
|---|---|---|---|---|
| Molar ratio | 1.00 | 1.34 | 0.47 | 0.095 |

**Table S4** Catalytic data in hydrodeoxygenation of vanillin over Pd/MSMF catalyst under various $H_2$ pressure.[a]

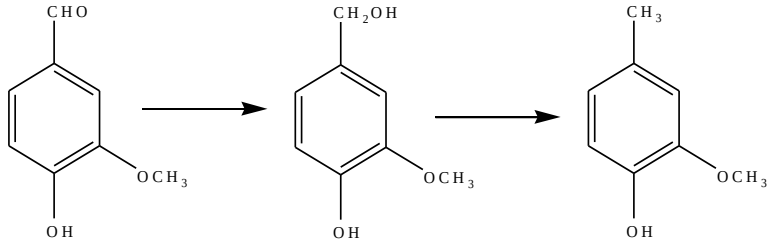



A B C

| Entry | Pressure (MPa) | Conv. (%) | Sel. (%) | |
|---|---|---|---|---|
| | | | B | C |
| 1 | 0.5 | >99.5 | 45.8 | 54.2 |
| 2 | 1 | >99.5 | 37.8 | 62.2 |
| 3 | 1.5 | >99.5 | 33.3 | 66.7 |
| 4 | 2 | >99.5 | 32.2 | 67.8 |
| 5 | 3 | >99.5 | 29.9 | 70.1 |

[a] Reaction conditions: 2 mmol of vanillin, S/C ratio at 200, 20 mL of water, temperature at 100°C, reaction for 1 h, Pd loading at 4.5 wt.%.

**Table S5** Catalytic data in hydrodeoxygenation of vanillin over Pd/MSMF catalyst at various temperature.[a]

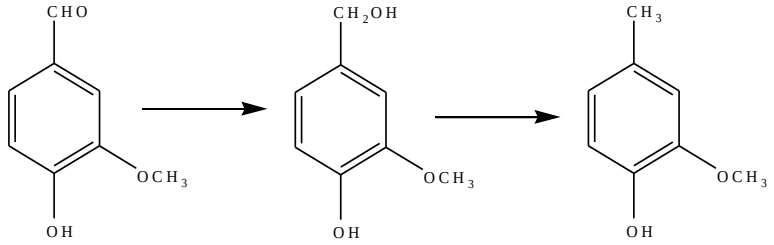



A B C

| Entry | Temperature (°C ) | Conv. (%) | Sel. (%) | |
|---|---|---|---|---|
| | | | B | C |
| 1 | 90 | >99.5 | 46.4 | 53.6 |
| 2 | 100 | >99.5 | 37.8 | 62.2 |
| 3 | 110 | >99.5 | 23.4 | 76.6 |
| 4 | 120 | >99.5 | 13.8 | 86.2 |
| 5 | 130 | >99.5 | 3 | 97 |
| 6 | 150 | >99.5 | ---- | >99.5 |

[a] Reaction conditions: 2 mmol of vanillin, S/C ratio at 200, 20 mL of water, pressure at 1 MPa, reaction for 1 h, Pd loading at 4.5 wt.%.

**Table S6** Catalytic data in hydrodeoxygenation of vanillin over Pd/MSMF catalyst under various recycles.[a]




A B C

| Entry | Conv. (%) | Sel. (%) |
|---|---|---|
| 1 | >99.5 | >99.5 |
| 2 | >99.5 | >99.5 |
| 3 | >99.5 | 93 |
| 4 | >99.5 | 94 |
| 5 | >99.5 | 98 |
| 6 | >99.5 | 87 |

[a] Reaction conditions: 2 mmol of vanillin, S/C ratio at 200, 20 mL of water, temperature at 110 °C, pressure at 1 MPa, reaction for 2 h, Pd loading at 4.5 wt.%.

**Supplementary Figure Captions**

**Figure S1.** A photograph of MSMF.

**Figure S2.** SEM image of MSMF.

**Figure S3.** HRTEM image of Pd/MSMF.

**Figure S4.** Contact angle of a (A) water and (B) 2-methoxy-4-methylphenol droplet on the surface of MSMF.

**Figure S5.** Pd3d XPS spectra of (a) Pd/C and (b) Pd/MSMF.

**Figure S6.** Dependence of conversion and selectivity in hydrodeoxygenation of vanillin on the $H_2$ pressure over Pd/MSMF catalyst at temperature of 100 °C in 20 mL of water as a solvent and 2 mmol of vanillin as a substrate for 1 h with S/C ratio of 200 and Pd loading at 4.5 wt.%.

**Figure S7.** Dependence of conversion and selectivity in hydrodeoxygenation of vanillin on the temperature over Pd/MSMF catalyst under $H_2$ pressure of 1 MPa in 20 mL of water as a solvent and 2 mmol of vanillin as a substrate for 1 h with S/C ratio of 200 and Pd loading at 4.5 wt.%.

**Figure S8.** TEM image of Pd/C.

***Figure S1***

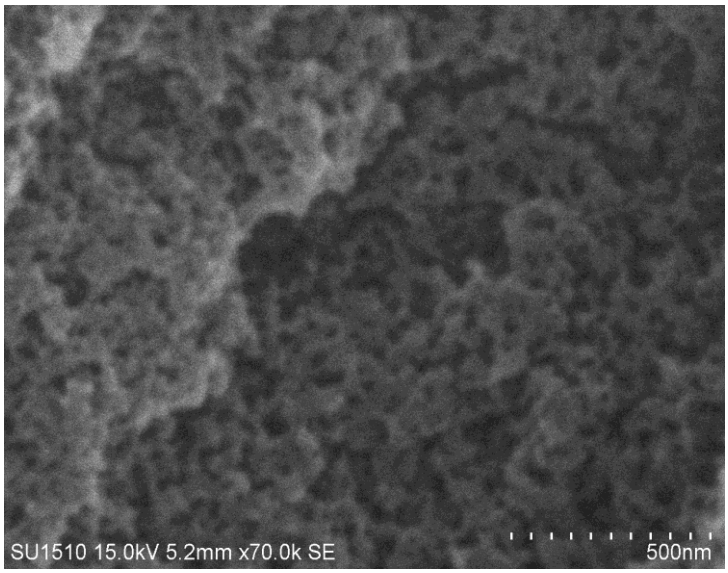



***Figure S2***

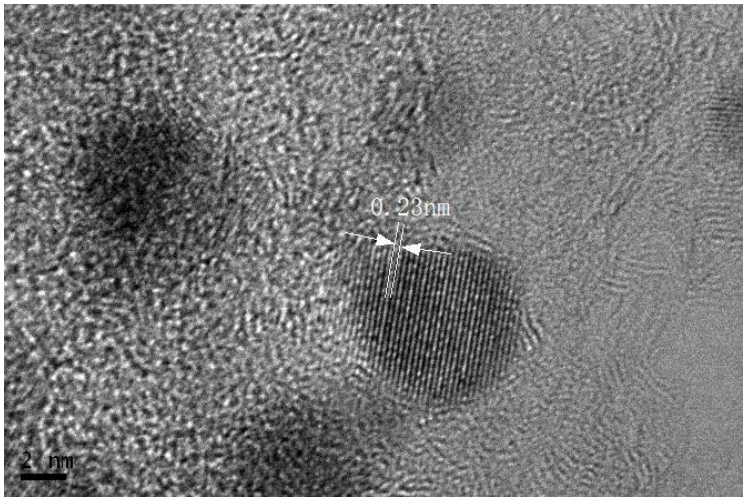



***Figure S3***

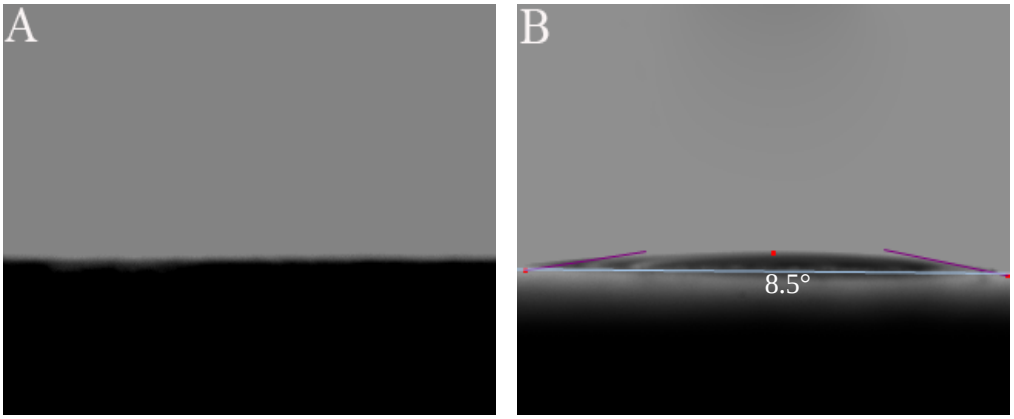



***Figure S4.***

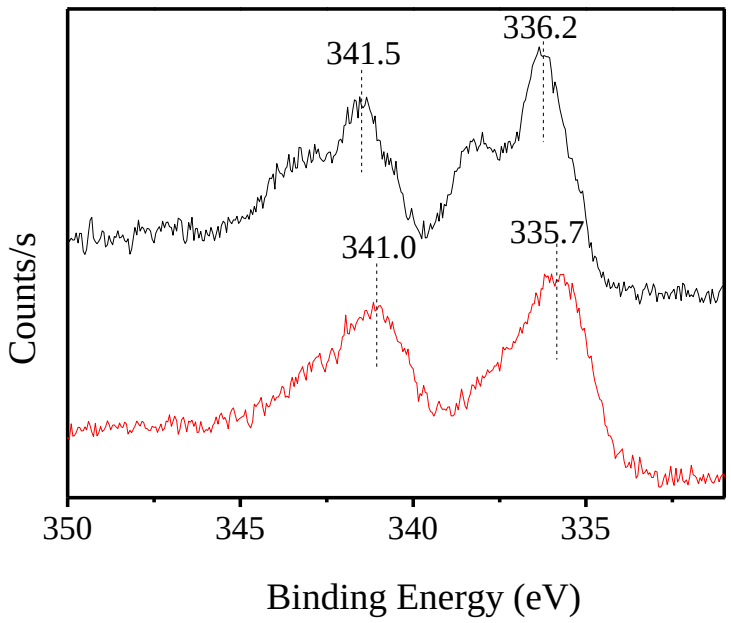



***Figure S5.***

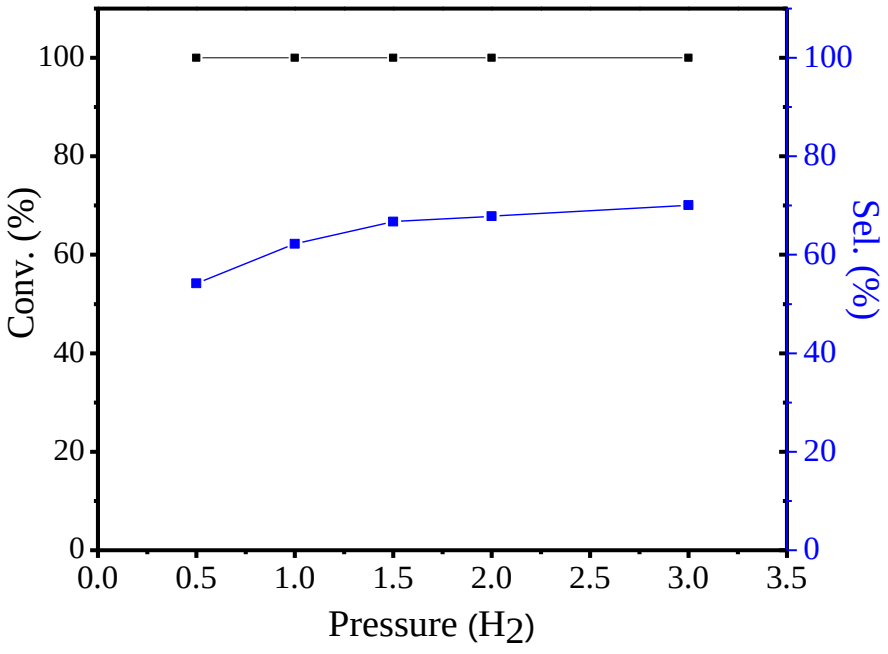



***Figure S6.***

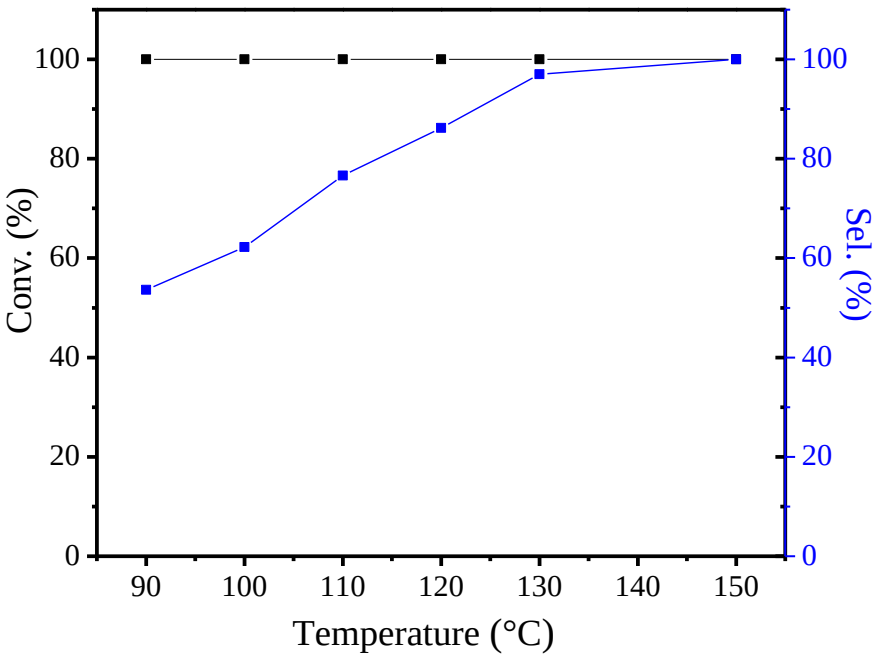



***Figure S7.***

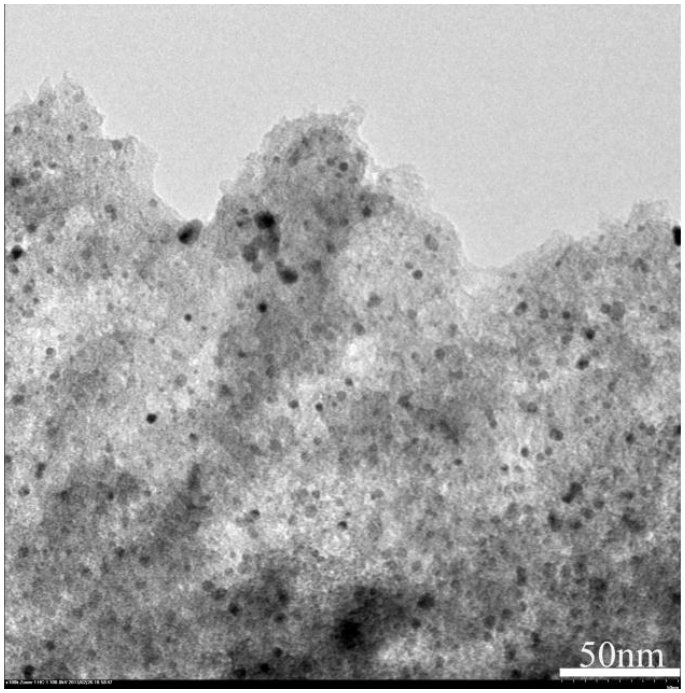



***Figure S8.***

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