

Supporting Information

One-pot preparation of Ru/ N-Doped Carbon catalyst for the hydroprocessing of lignin oil

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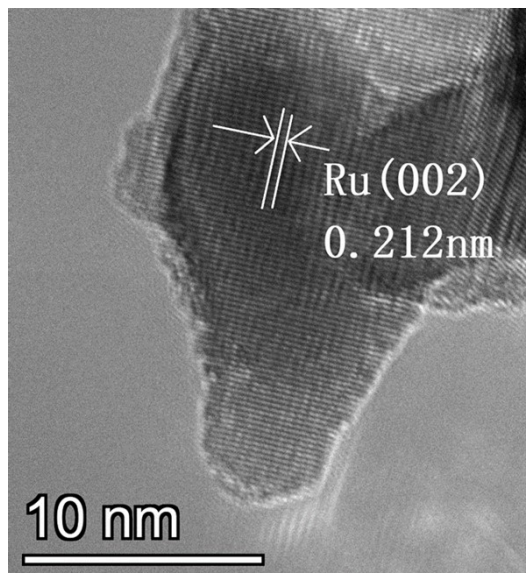


Figure S1. TEM images of Ru/NC-M.

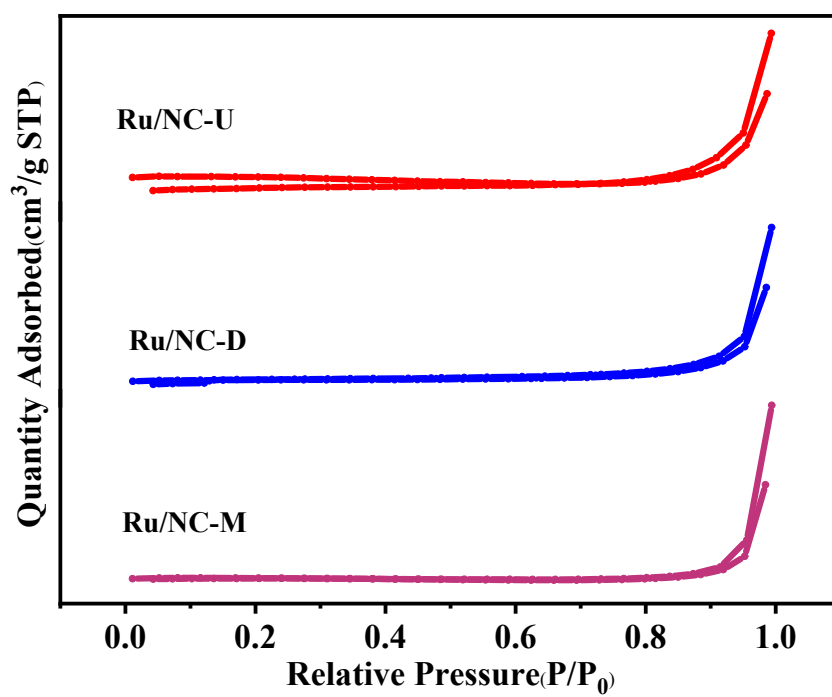


Figure S2. N₂ adsorption isotherm.

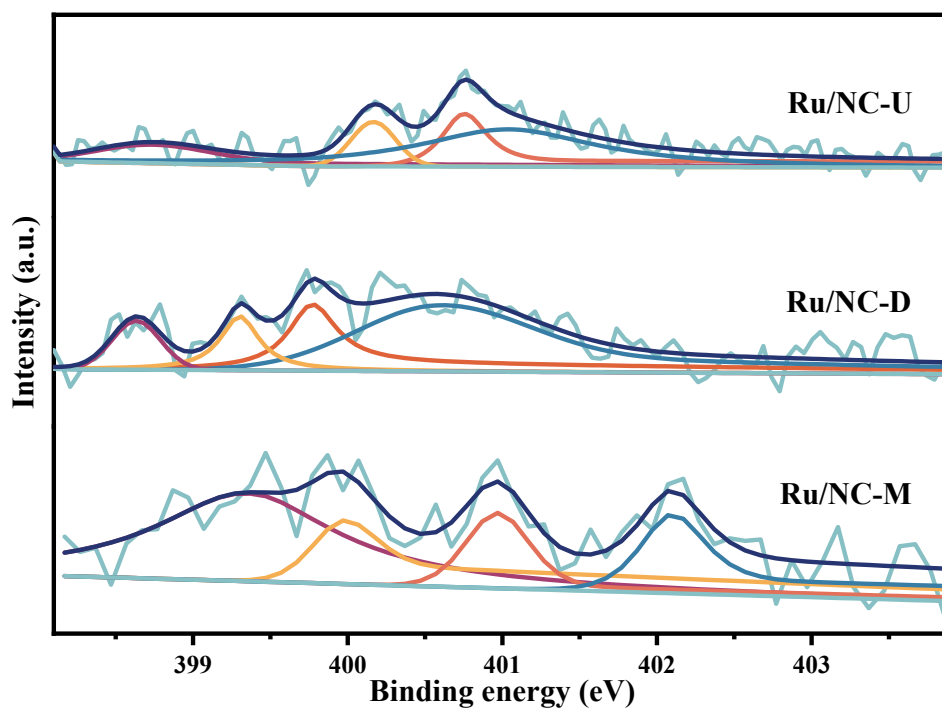


Figure S3. XPS spectra of catalysts N 1s.

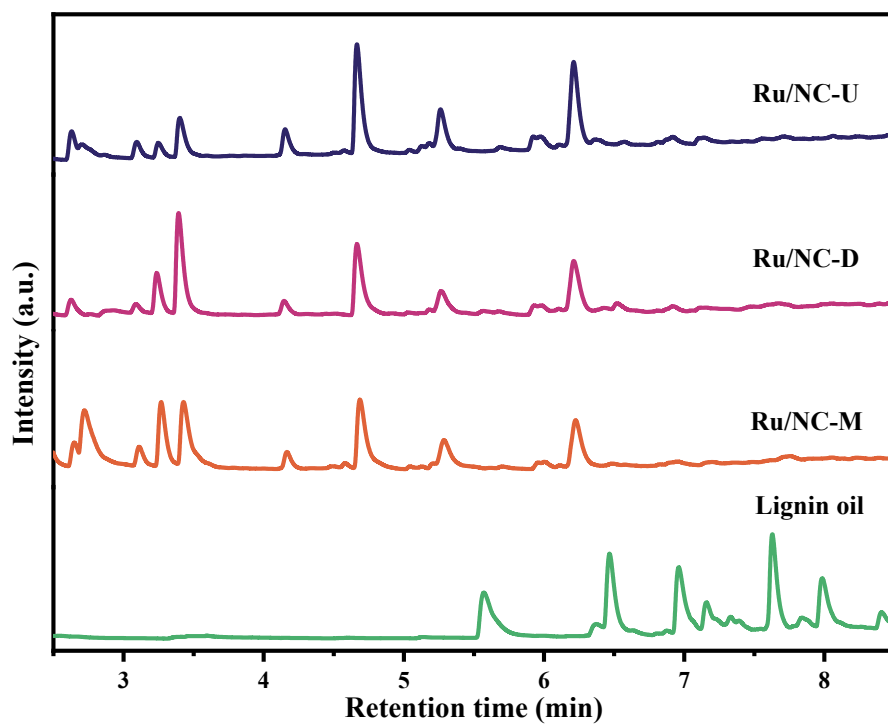


Figure S4. Hydrogenolysis of lignin oil over different catalysts

Reaction conditions: 100 mg lignin oil, 50 mg catalyst, 30 mL isopropanol, 240 °C,

1MPa H₂, 7 h, 800 rpm

Table S1. ICP-MS analysis for the Ru/ N-doped carbon catalysts.

Catalysts	ICP-MS analysis(wt%)
	Ru
Ru/NC-U	6.40
Ru/NC-D	7.50
Ru/NC-M	3.24

Table S2. BET surface area, Pore volume and Pore diameter of catalysts.

Catalysts	S_{BET} (m^2g^{-1})	Pore volume (cm^3g^{-1})	Pore diameter (nm)
Ru/NC-U	2.20	0.007	30.65
Ru/NC-D	2.60	0.02	34.96
Ru/NC-M	8.62	0.019	40.84

Table S3. The various Ru species content of the Ru/N-doped Carbon Catalysts.

Catalyst	Ru ⁰	Ru ⁿ⁺
Ru/NC-U	65.50	34.50
Ru/NC-D	59.14	40.86
Ru/NC-M	71.94	28.06

Table S4. The data of Pyridine-IR

Catalyst	Acid sites(μmolg^{-1})			
	Lewis	Bronsted	Total	L/B
Ru/NC-U	33.09	2.19	35.28	15.11
Ru/NC-D	39.24	2.53	41.77	15.51
Ru/NC-M	65.15	3.57	68.72	18.25

Table S5. The comparison of catalytic performance between the Ru/NC-M and previous reported catalysts.

Catalyst	Loading of metals	Reaction conditions	Conversion(%)	Ref.
Pt-Ni/SO ₄ ²⁻ /ZrO ₂ /SBA-15	2wt% Pt 10wt% Ni	260°C, 5MPaH ₂	62.37	1
Pt/C	5wt%	300°C, 1MPaH ₂	87	2
Pt/NC	5wt%	400°C, H ₂ : 80 sccm, N ₂ : 19.5 sccm	100	3
Ru/15WZr(syn)	5wt%	270°C, 4MPaH ₂	98.5	4
Ru/HZSM-5	5wt%	240°C, 2MPaH ₂	63	5
Ru/NC-M	3.2wt%	240°C, 1MPaH ₂	100	This work

References:

1. Chen W, Luo Z and Yu C. Fuel processing technology, 2014, **126**, 420-428.
2. Gao D, Schweitzer C and Hwang H T. Industrial & Engineering Chemistry Research, 2014, **53**, 18658-18667.
3. Liu C, Zhou C and Wang Y. Proceedings of the Combustion Institute, 2021, **38**, 4345-4353.
4. Dwiatmoko A A, Kim I and Zhou L. Applied Catalysis A: General, 2017, **543**, 10-16.
5. Luo Z, Zheng Z and Wang Y. Green Chemistry, 2016, **18**, 5845-5858.

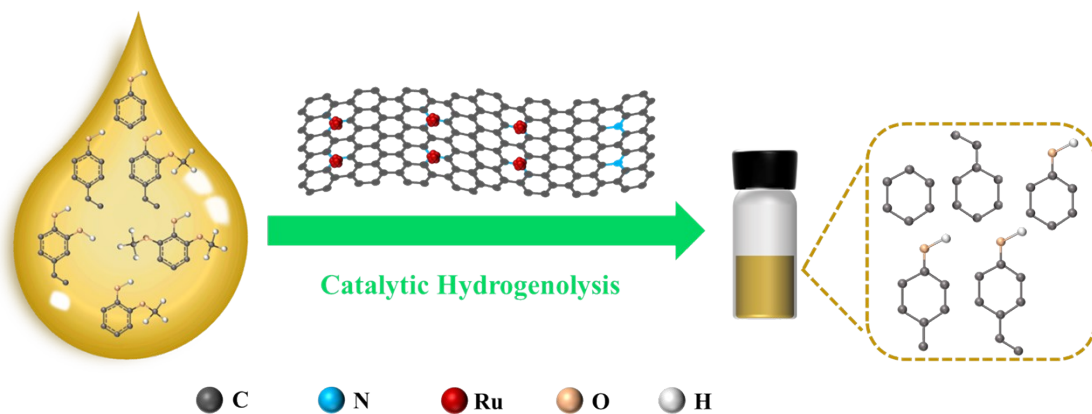


Figure S5. Graphical abstract.