

Electronic Supplementary Information

X-ray absorption spectroscopy of Ba- and Cs-promoted Ru/Mesoporous carbon catalysts for long-term ammonia synthesis under intermittently varied conditions

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Table S1 – Analysis of Ru *K*-edge XANES spectra of prepared 0.5Ba-10Ru/AC, 0.5Ba-10Ru/MPC, 2.5Cs-10Ru/AC, and 2.5Cs-10Ru/MPC catalysts.

	RuO ₂ (%)	Ru (%)
0.5Ba-10Ru/MPC	75.8	24.2
0.5Ba-10Ru/AC	84.1	15.9
2.5Cs-10Ru/MPC	68.0	32.0
2.5Cs-10Ru/AC	86.6	13.4

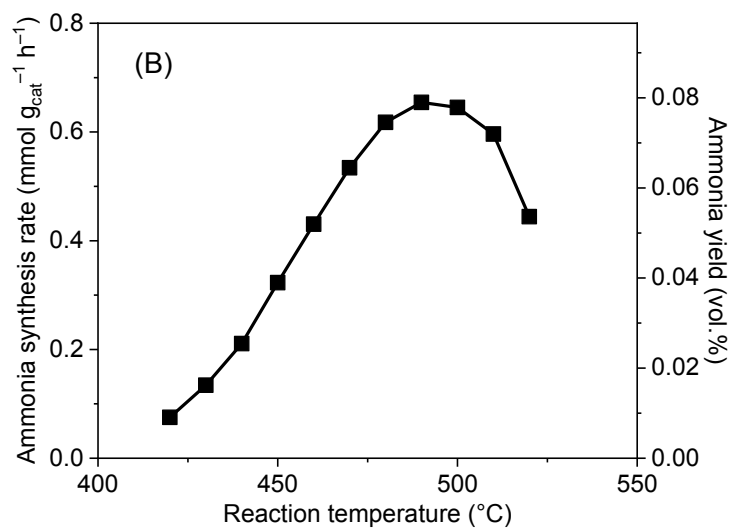
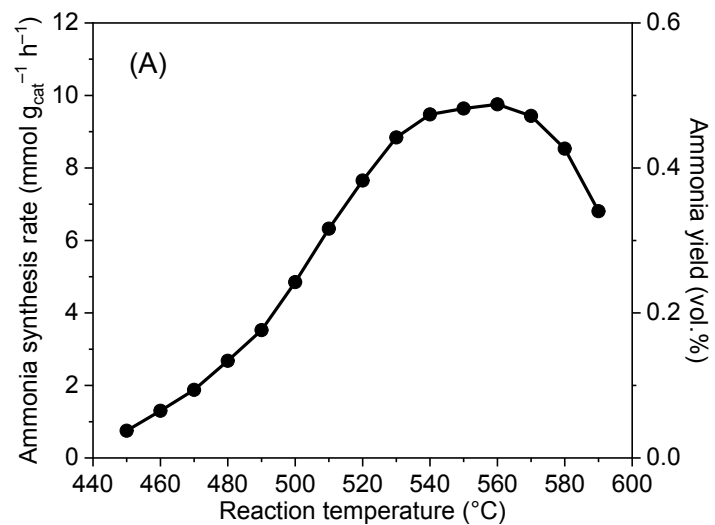


Fig. S1 – Temperature dependence of ammonia synthesis rate and yield over (A) 10Ru/MPC and (B) 10Ru/AC catalysts at 0.99 MPa, H₂/N₂ = 3, GHSV = 9,000 h⁻¹.

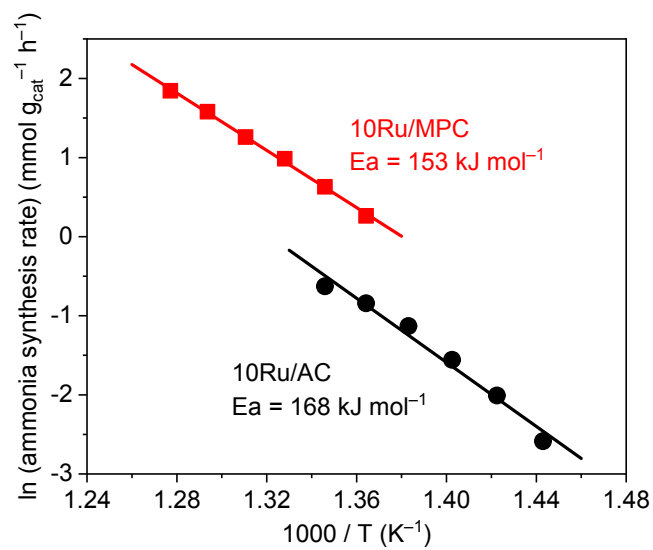


Fig. S2 – Arrhenius plots for ammonia synthesis over 10Ru/AC and 10Ru/MPC catalysts under mild conditions using a H₂ pressure of 0.99 MPa and a GHSV value of 9,000 h⁻¹ using a mixed gas of H₂ and N₂ with a H₂/N₂ ratio of 3.

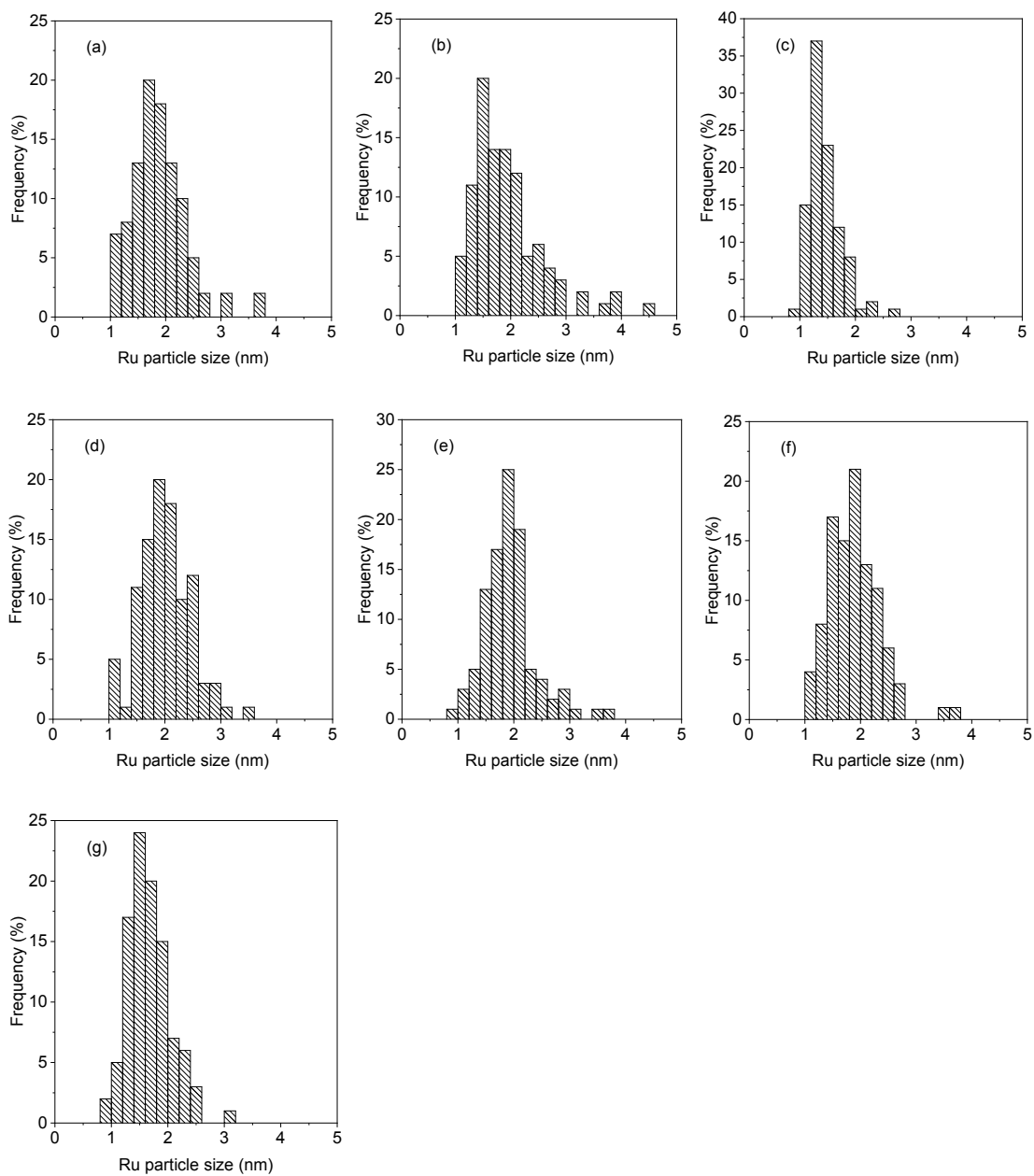


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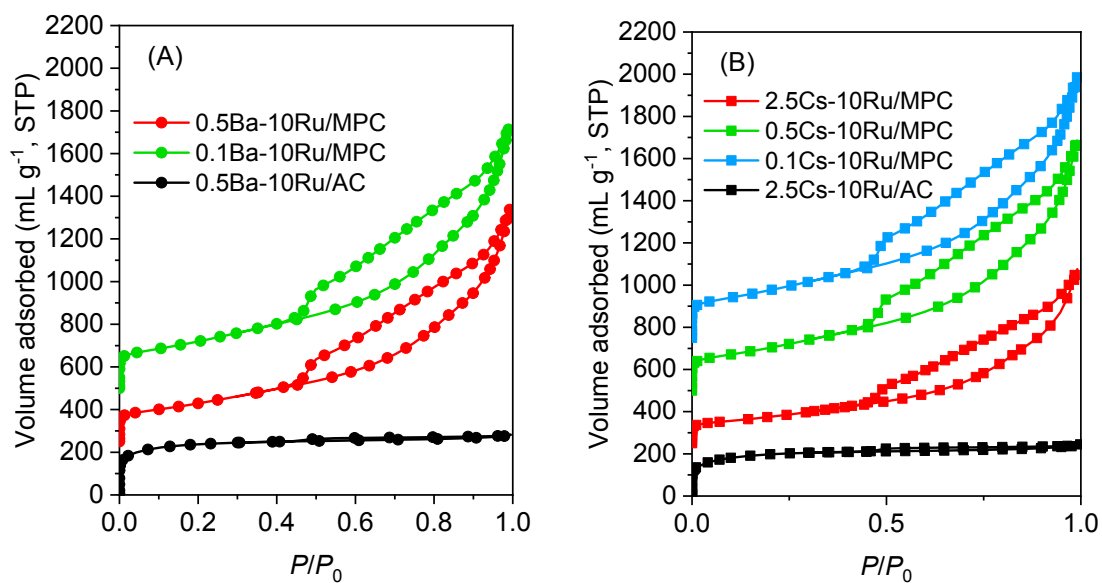


Fig. S4 – Nitrogen adsorption-desorption isotherms of (A) γ Ba-10Ru/AC and γ Ba-10Ru/MPC catalysts and (B) χ Cs-10Ru/AC and χ Cs-10Ru/MPC catalysts.

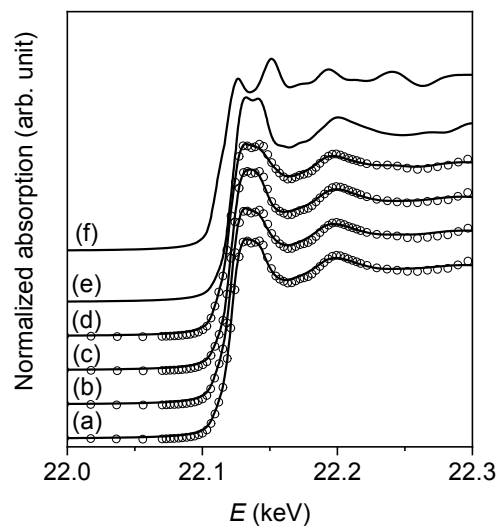


Fig. S5 – Ru *K*-edge XANES spectra for prepared (a) 0.5Ba-10Ru/AC, (b) 0.5Ba-10Ru/MPC, (c) 2.5Cs-10Ru/AC, (d) 2.5Cs-10Ru/MPC catalysts and standards—(e) RuO₂ and (f) metallic Ru. The experiment data are represented as the solid curves and the fitting data of the linear combination of RuO₂ and metallic Ru components are presented as the empty circles.

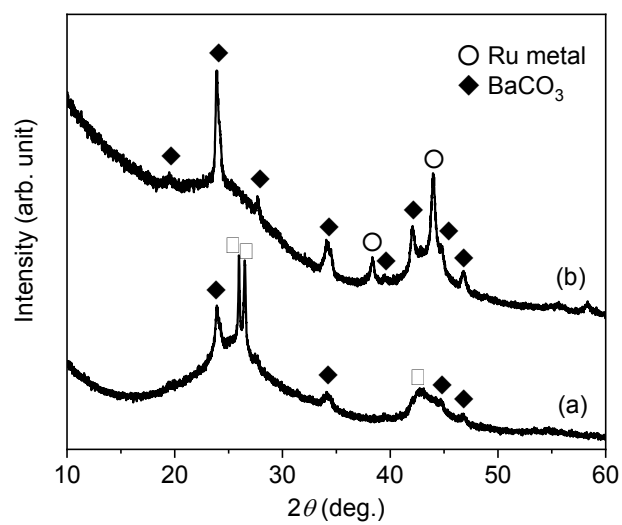


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