

Enhanced catalytic activity and thermal stability by highly dispersed Pd-based nanocatalysts embedded in ZrO₂ hollow spheres

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Supplementary material

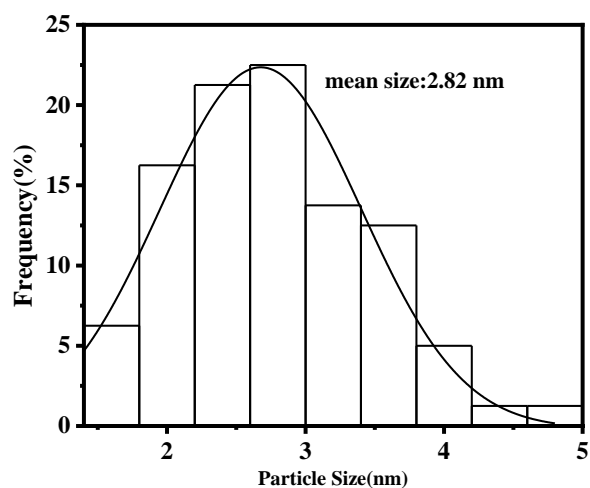


Fig. S1 Size distribution of Pd nanoparticles.

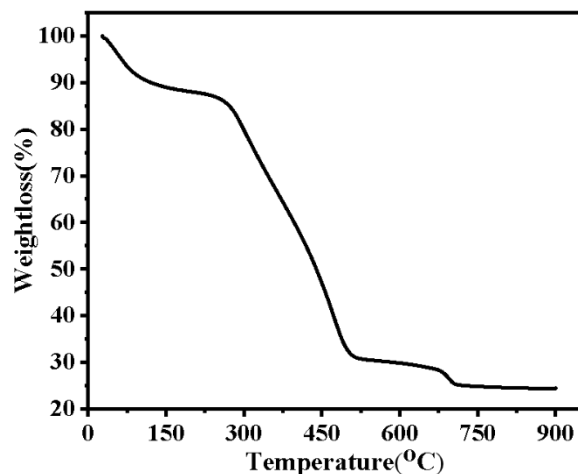


Fig. S2 TG test of CSs@Pd@ZrO₂.

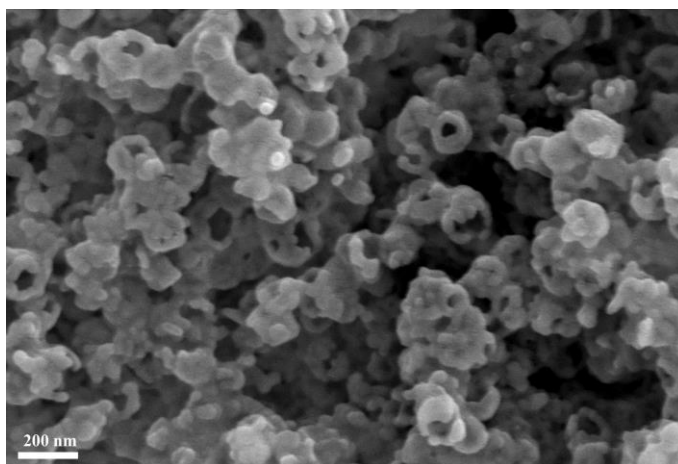


Fig. S3 TEM image of Pd@HS-ZrO₂-900.

Table S1 Comparison of some catalysts for the CO oxidation by thermocatalysis

Catalyst	Reaction condition	Maximum removal efficiency	Ref.
CuCe _x /TiO ₂	50 mg catalyst, 4.5% CO + 2.23% O ₂ at 50 mL·min ⁻¹	T ₅₀ = 400 °C	[S1]
La _{0.8} Sr _{0.2} CoO ₃	100 mg catalyst, 1% CO + 5% O ₂ + 94% N ₂ at 60 mL·min ⁻¹	T ₉₀ = 191 °C	[S2]
Mn ₃ Co ₁₆ O _x	200 mg catalyst, 0.15% CO + 18.9% O ₂ + 80.95% at 15000 mL·(g _{cat} ·h) ⁻¹	T ₁₀₀ = 55 °C	[S3]
Ce@CuMn ₈ O _x	100 mg catalyst, 2.5 vol.% CO in air at 60 mL·min ⁻¹	T ₁₀₀ = 65 °C	[S4]
0.5Pd-66 (0.5 wt.% Pd supported on UiO-66)	100 mg catalyst, 1.05% CO + 20% O ₂ + N ₂ balanced at 30 mL·min ⁻¹	T ₁₀₀ = 165 °C	[S5]
Mn-MIL-100	100 mg catalyst, He/CO/O ₂ = 79/1/20 at a total flow rate of 30 mL·min ⁻¹	T ₉₈ = 240 °C	[S6]
Au/TiO ₂	200 mg catalyst, CO/O ₂ /N ₂ = 1/1/98 (vol.%); space velocity: 18000 mL·(g _{cat} ·h) ⁻¹	T ₉₀ = 120 °C	[S7]
Ag/CeO ₂ -600	200 mg catalyst, 0.2 vol.% CO, 1.0 vol.% O ₂ , 0.5 vol.% Ne, balance He was fed at a rate of 1000 cm ⁻³ ·min ⁻¹ ; space velocity: 240000 h ⁻¹	T ₅₀ = 100 °C	[S8]

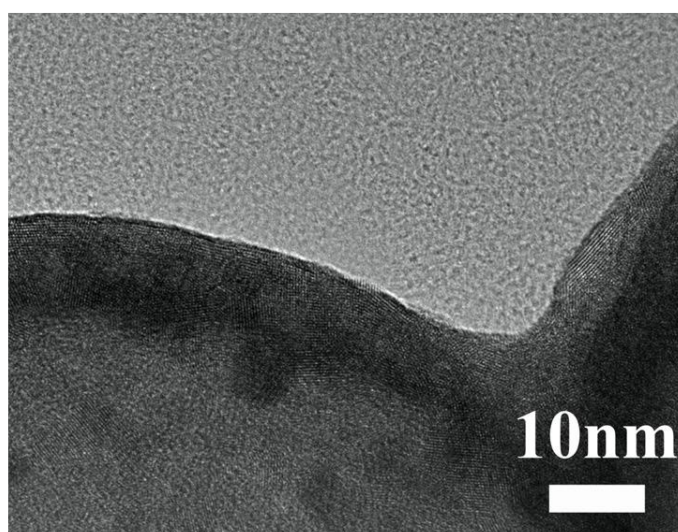


Fig. S4 TEM images of Pd@HS-ZrO₂-450.

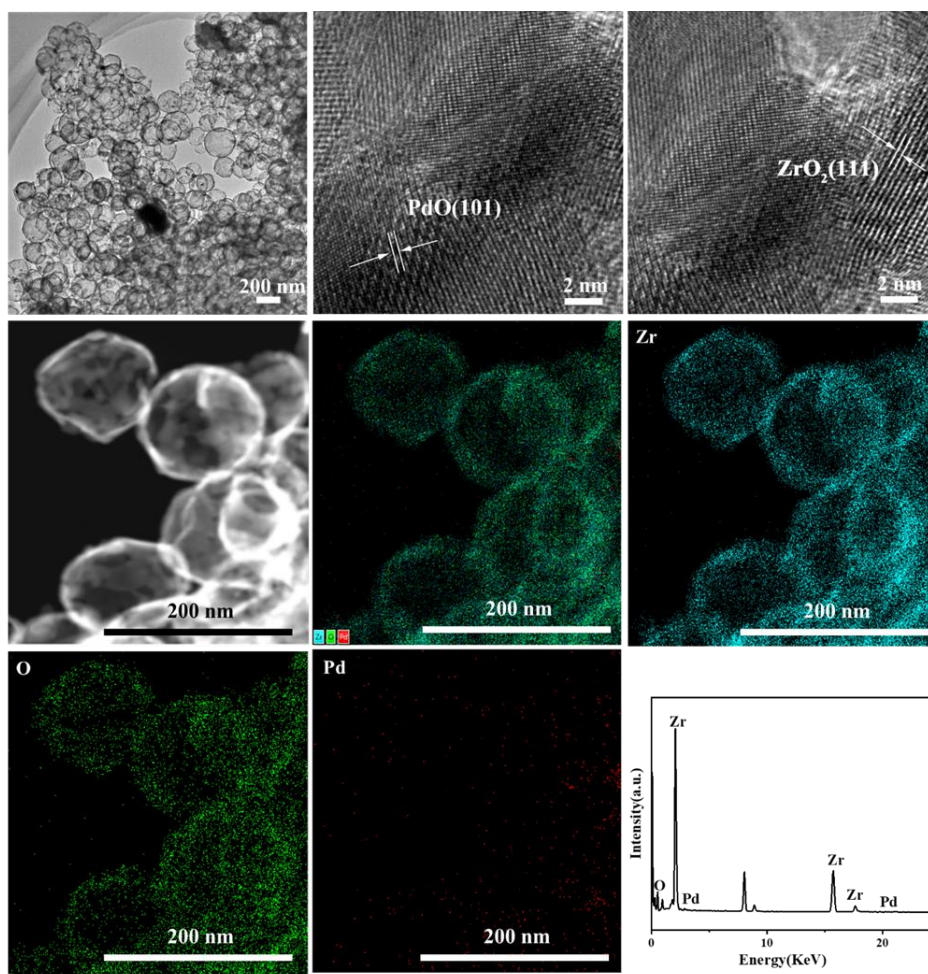


Fig. S5 TEM images, element mapping images, and EDS energy spectrum of Pd@HS-ZrO₂-800.

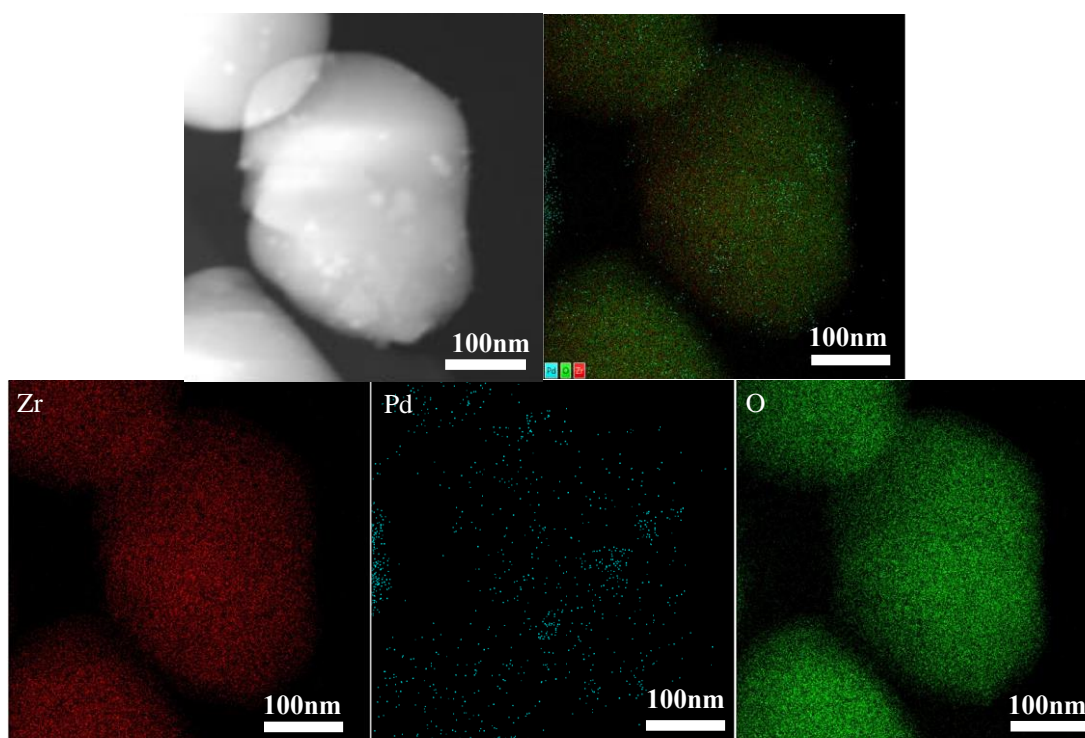


Fig. S6 TEM and element mapping images of Pd/ZrO₂-450.

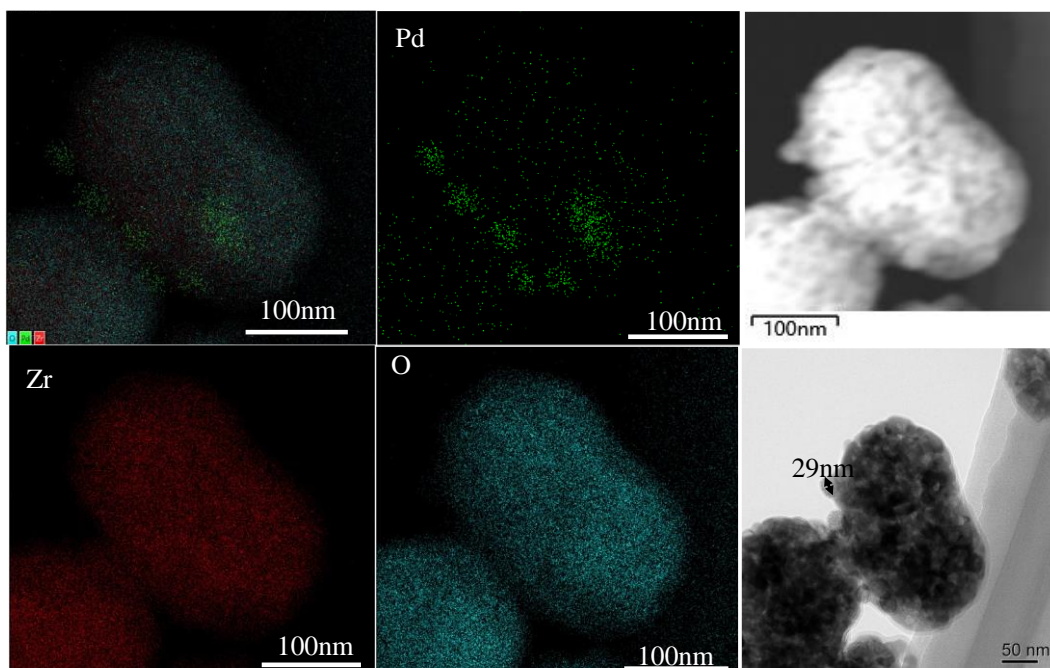


Fig. S7 TEM and element mapping images of Pd/ZrO₂-800.

Comparing Figs. S6 and S7, it can be clearly observed that noble metal particles have grown to more than 20 nm when the Pd/ZrO₂ calcination temperature increases from 450 to 800 °C.

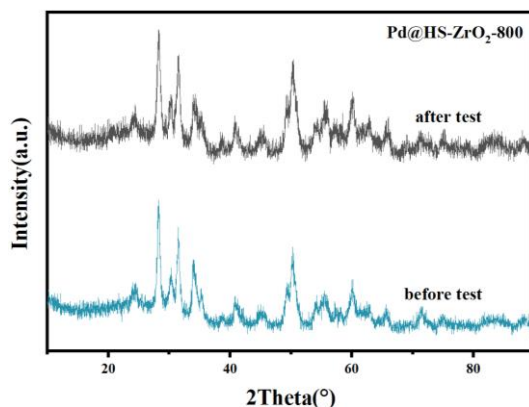


Fig. S8 XRD patterns of Pd@HS-ZrO₂-800.

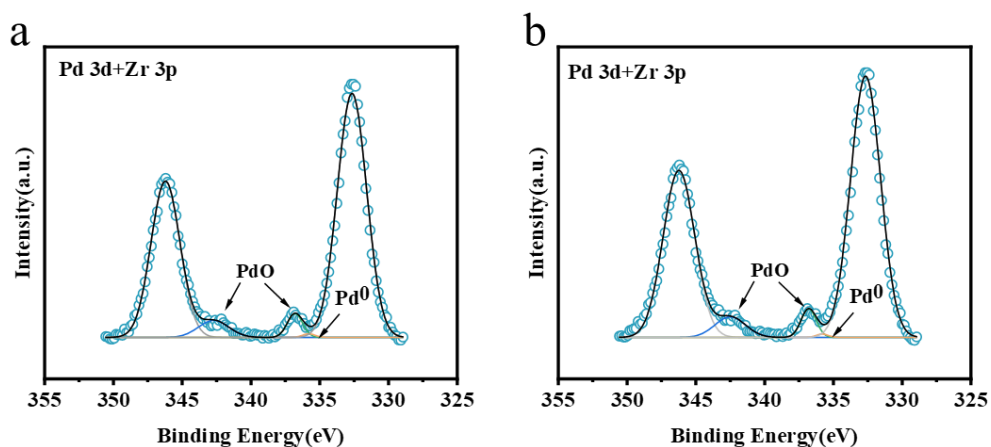


Fig. S9 XPS spectra of Pd 3d + Zr 3p of Pd@HS-ZrO₂-800 samples: (a) before test; (b) after test.

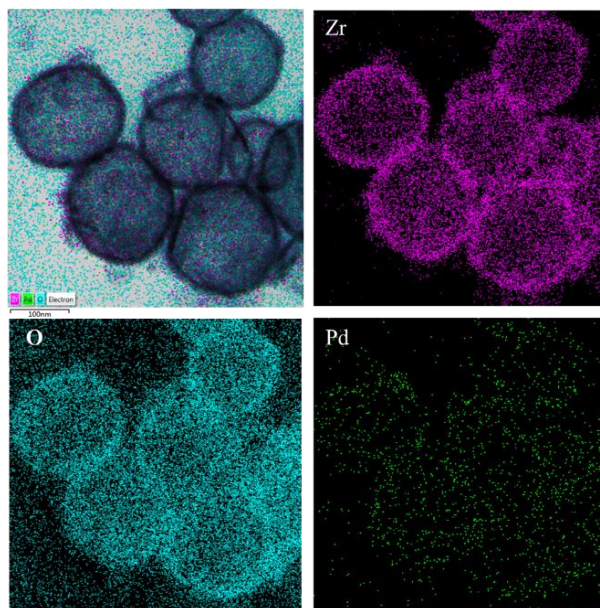


Fig. S10 EDS-mappings of Pd@HS-ZrO₂-800 catalyst.

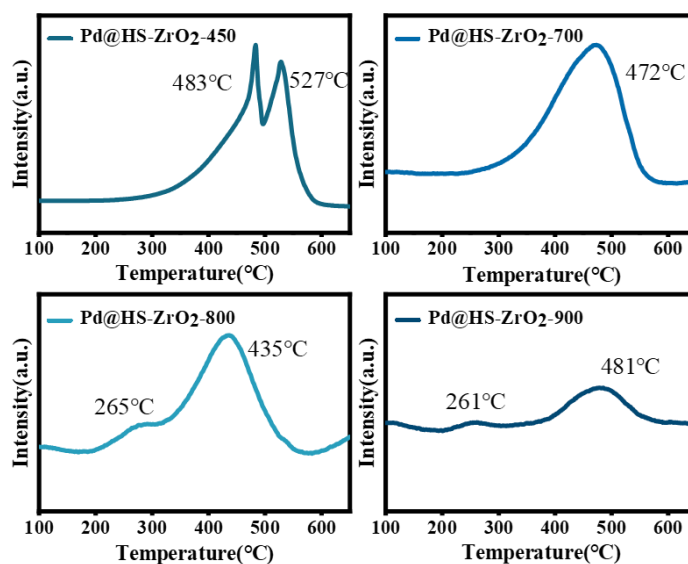


Fig. S11 H₂-TPR profiles of Pd@HS-ZrO₂.

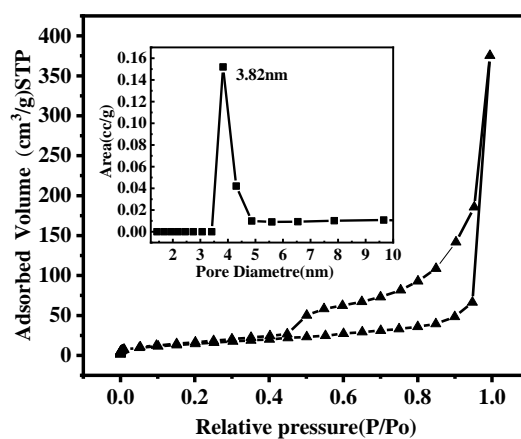


Fig. S12 N₂ adsorption–desorption isotherms and pore size distribution of Pd@HS-ZrO₂-800.

References

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