Supporting Information

Enhancing the Low-temperature Performance of Pt-based Three-way Catalysts Using CeO_2(core)@ZrO_2(shell) Supports

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Table S1. BET surface area of all studied supports (calcined at 500 °C for 2 h in static air).

Sample	Surface area (m^2/g)
CeO_2 sphere	83.6
$0.9CeO_2@0.1ZrO_2$	93.5
$0.8CeO_2@0.2ZrO_2$	87.2
$0.7CeO_2@0.3ZrO_2$	95.0
$0.5CeO_2@0.5ZrO_2$	69.3
$Ce_{0.9}Zr_{0.1}O_2$	77.2

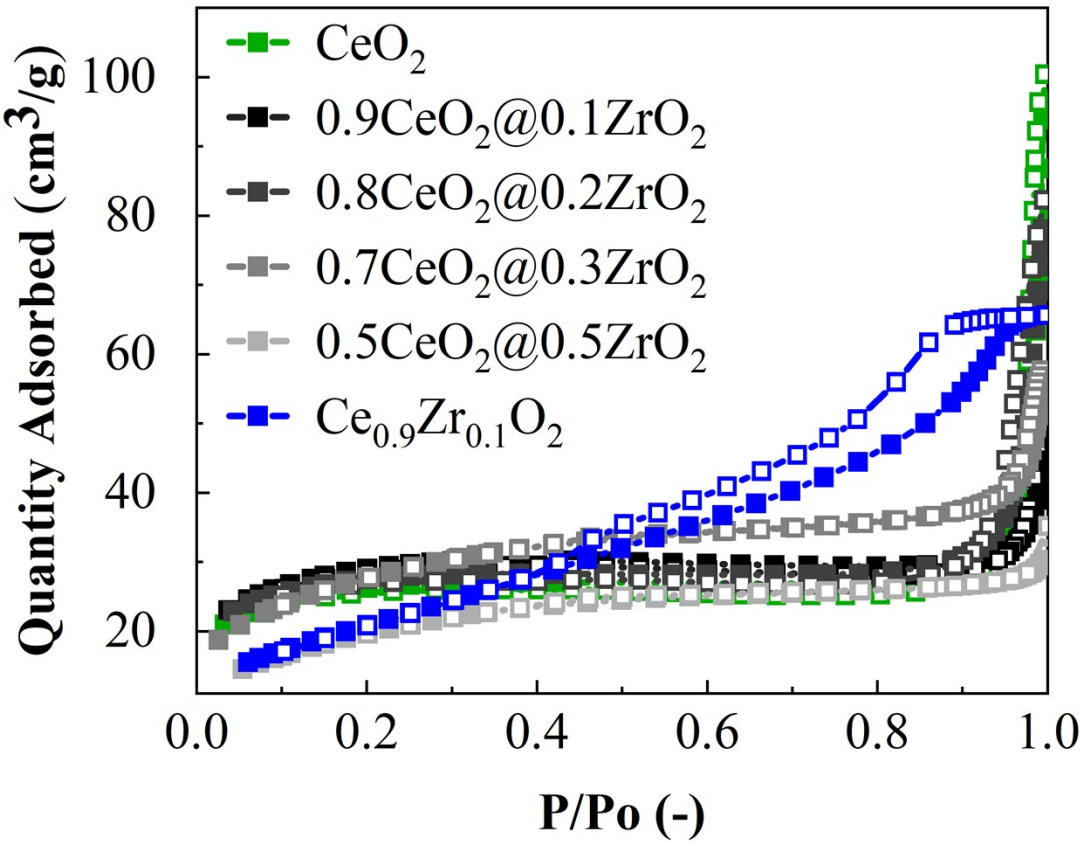

Fig. S1. N_2 adsorption (solid) – desorption (open) isotherms of (1-x)CeO_2@xZrO_2 (where x = 0, 0.1, 0.2, 0.3, and 0.5) and $Ce_{0.9}Zr_{0.1}O_2$ supports.

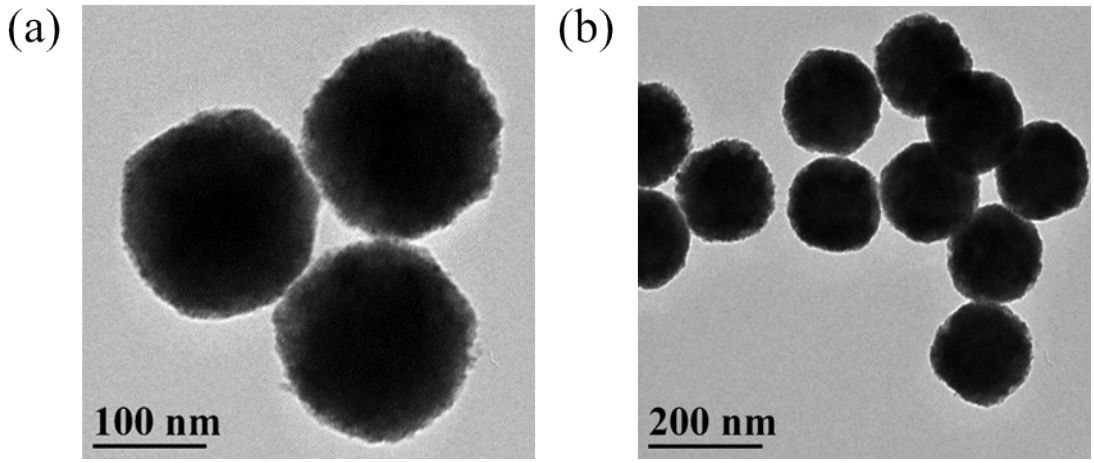

Fig. S2. HRTEM images of CeO_2 spheres.

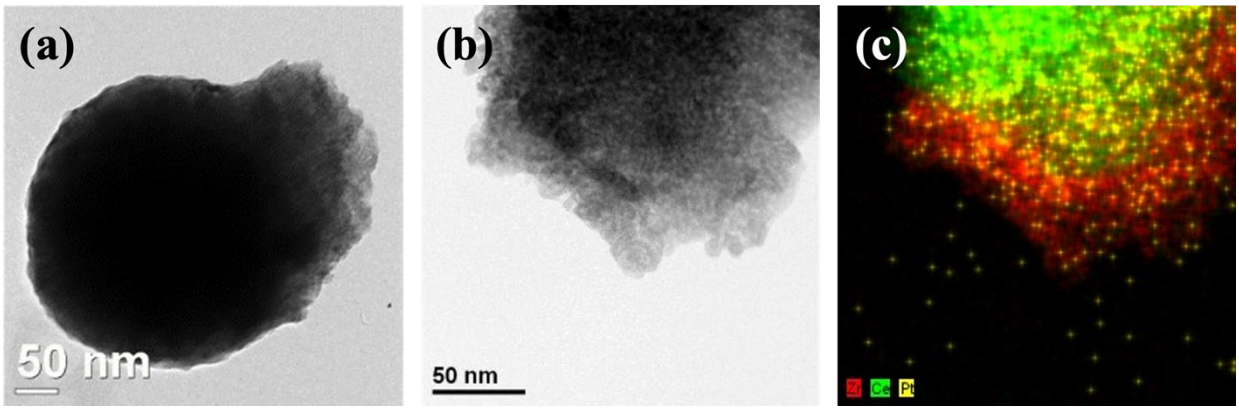

Fig. S3. (a) HRTEM images of $0.5CeO_2@0.5ZrO_2$ support. (b) HRTEM and (c) EDS elemental maps of $Pt/0.5CeO_2@0.5ZrO_2$ showing non-uniform coverage of ZrO_2 on the surface of CeO_2.

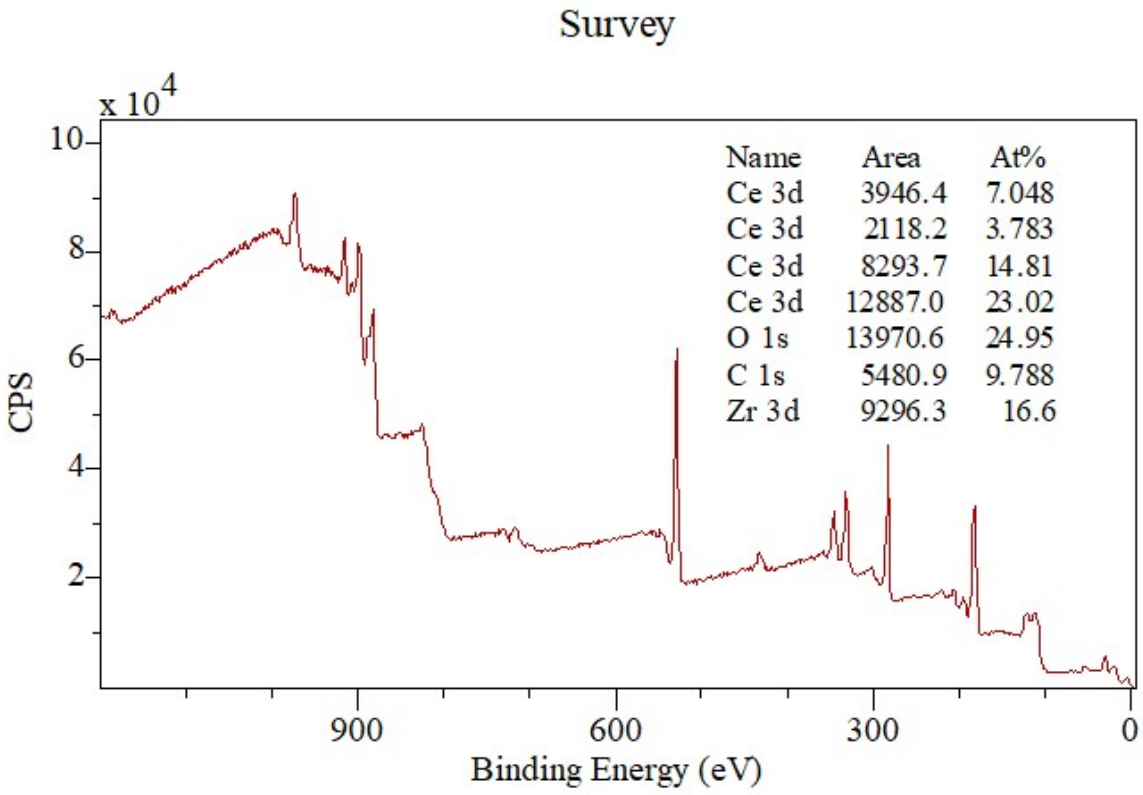

Fig. S4. XPS survey scan of $0.9CeO_2@0.1ZrO_2$.

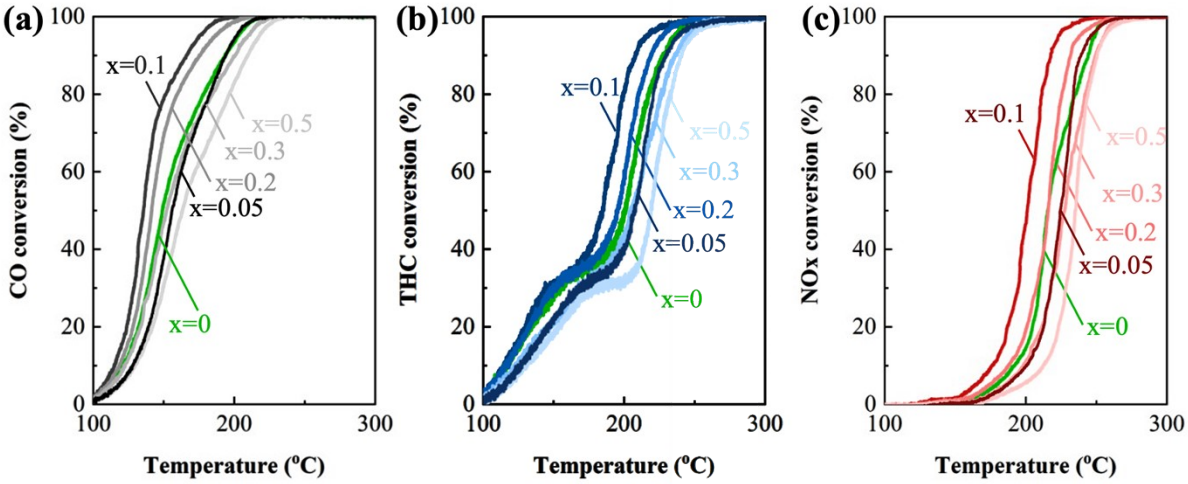

Fig. S5. Light off curves of (a) CO, (b) THCs, and (c) NO_x over DG 1.8 wt.% Pt/(1-x)CeO_2@xZrO_2 (DG) (x = 0, 0.1, 0.2, 0.3, 0.5) catalysts.

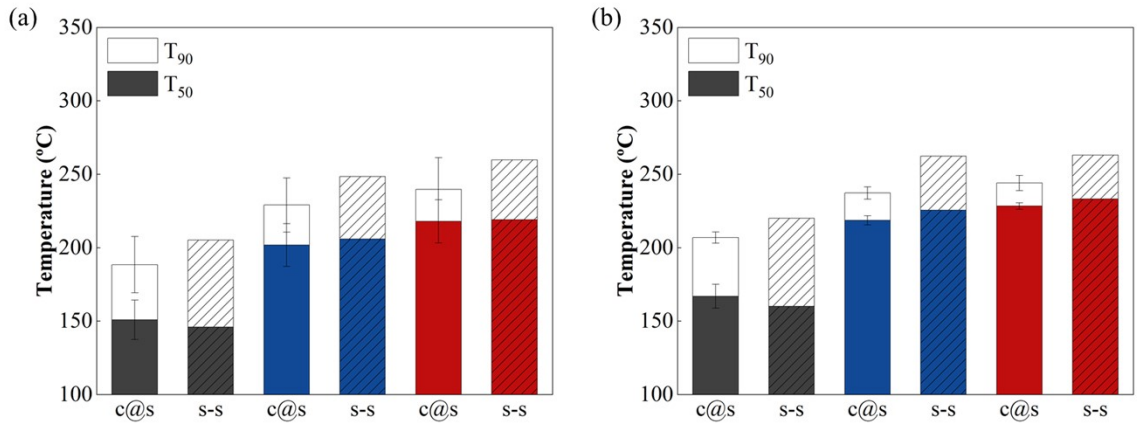

Fig. S6. Comparison of $T_{50,90}$'s of CO (black), THC (blue), and NO_x (red) for (a) DG and (b) HTA 1.8 wt.% Pt/0.9CeO_2@0.1ZrO_2 (c@s) and 1.8 wt.% Pt/$Ce_{0.9}Zr_{0.1}O_2$ (s-s) catalysts.

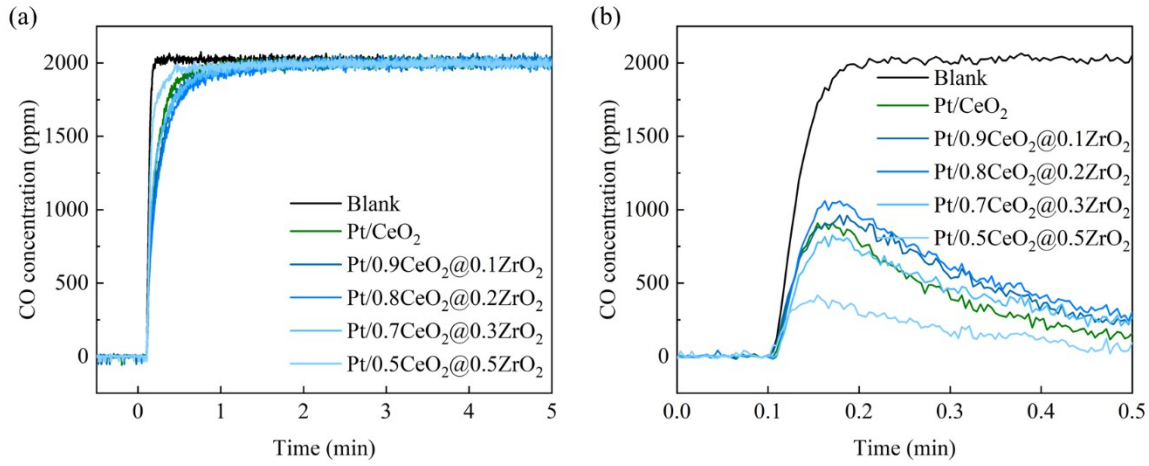

Fig. S7. (a) Effluent CO concentration and (b) CO concentration subtracted from the empty reactor (blank) effluent CO over Pt/(1-x)CeO_2@xZrO_2 (x = 0, 0.1, 0.2, 0.3, 0.5) catalysts.

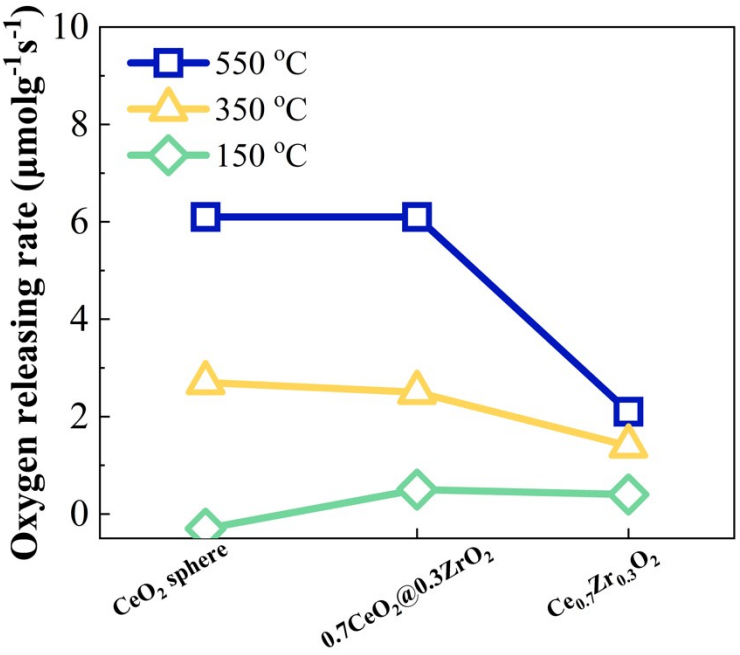

Fig. S8. Oxygen releasing rate of CeO_2 sphere, $0.7CeO_2@0.3ZrO_2$, and $Ce_{0.7}Zr_{0.3}O_2$ solid solution at 150, 350, and 550 °C.

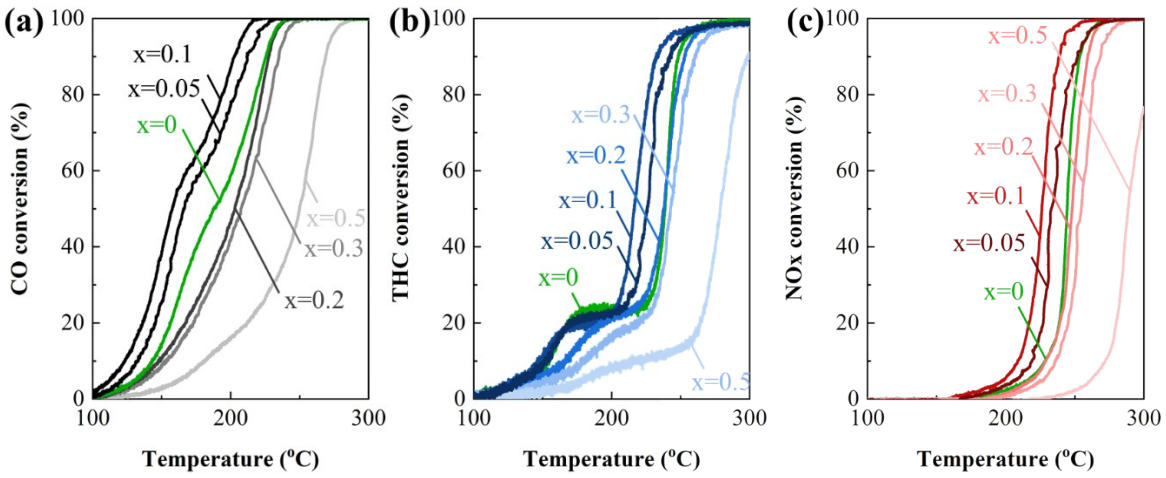

Fig. S9. Light off curves of (a) CO, (b) THCs, and (c) NO_x over HTA 1.8 wt.% Pt/(1-x)CeO_2@xZrO_2 (HTA) (x = 0, 0.1, 0.2, 0.3, 0.5) catalysts.

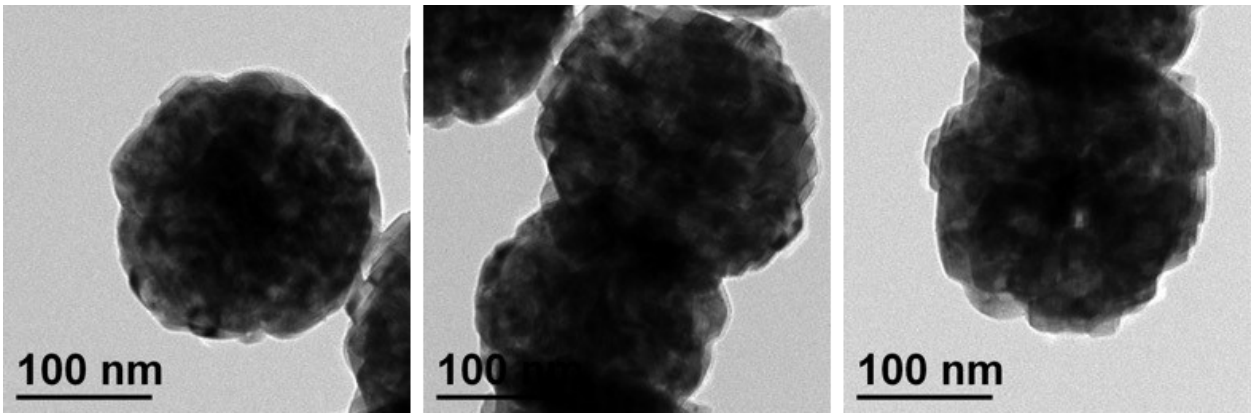

Fig. S10. TEM images of Pt/0.9CeO_2@0.1ZrO_2 after redox HTA.

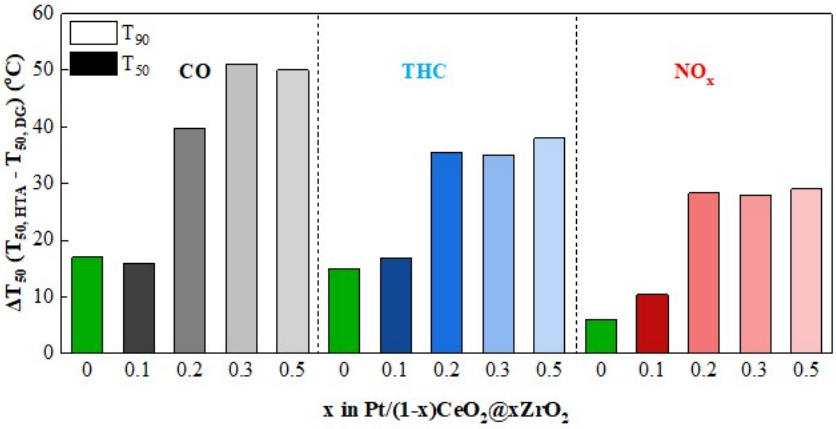

Fig. S11. ΔT_{50} (= $T_{50,HTA} - T_{50,DG}$) of CO, THC, and NO_x over 1.8 wt.% Pt/(1-x)CeO_2@xZrO_2 (x = 0, 0.1, 0.2, 0.3, 0.5) catalysts.