Three-dimensional nitrogen-doped porous carbon anchored CeO$_2$ quantum dots as an efficient catalyst for formaldehyde oxidation

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**Fig. S1.** SEM image of PMMA spheres.

**Fig. S2.** a) TEM, b) HRTEM images of CeO$_2$@CN, TEM image of c) CeO$_2$/CN and d) bulk CeO$_2$. 
Fig. S3. a) $N_2$ adsorption-desorption isotherm and b) DFT pore size distribution of CeO$_2$@CN.

Fig. S4. a) $N_2$ adsorption-desorption isotherm and b) DFT pore size distribution of bulk CeO$_2$.

Fig. S5. TG curve of CeO$_2$@CN synthesized with different mass ratio of ceric ammonium nitrate to dopamine calcined at 650 °C and Ar atmosphere.
**Fig. S6.** Deconvolution of Ce 3d XPS spectrum of 3D-CeO$_2$@CN and bulk CeO$_2$.

**Fig. S7.** HCHO oxidation conversion values as function of temperature at 100000 h$^{-1}$ over 3D-CeO$_2$@CN with a) different calcination temperature at ceric ammonium nitrate to dopamine of 20/1, b) with different ratio of ceric ammonium nitrate to dopamine at calcination temperature of 650 °C.
Fig. S8. HCHO oxidation conversion values as function of temperature over CeO$_2$@CN, CeO$_2$/CN and CeO$_2$ at 100000 h$^{-1}$. 

![Graph showing HCHO conversion vs temperature with different catalysts](image-url)