Electronic Supplementary Material (ESI) for Dalton Transactions

Supporting Information

Water-Soluable Au-CeO_2 Hybrid Nanosheets with High Catalytic Activity and Recyclability

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Experimental Section:

Synthesis of Au-CeO_2 nanosheets:

In a typical experiment, 0.5 mmol $Ce(NO_3)_3$, 0.5 mmol L-lysine, and 20 mL water were mixed together to form a transparent solution, followed by dropping the aqueous solution containing 0.1 mmol $HAuCl_4$ and 0.5 mmol PVP. After stirring for 10 min, 50 μL tert-butylamine were added in the mixture that was then heated to 80 ^oC and kept for one hour. The products were purified by centrifugation and washed with water for three times, then dried at 80 ^oC over night.

Characterization:

The X-ray diffraction pattern of the products was collected on a Rigaku-*D*/max 2500 V X-ray diffractometer with Cu-K_α radiation (λ = 1.5418 Å), with an operation voltage and current maintained at 40 kV and 40 mA. Transmission electron microscopic (TEM) images were obtained with a TECNAI G2 high-resolution transmission electron microscope operating at 200 kV. XPS measurement was performed on an ESCALAB-MKII 250 photoelectron spectrometer (VG Co.) with Al K_α X-ray radiation as the X-ray source for excitation. UV-vis absorption measurements were carried out using a Shimadzu UV-3600 Spectrophotometer.

Catalytic tests:

The aqueous solutions of *p*-nitrophenol (0.1 mmol/mL) and $NaBH_4$ (0.5 mmol/mL) were freshly prepared. 20 μL *p*-nitrophenol and 1 mL $NaBH_4$ aqueous were mixed in 3 mL H_2O. Then 40 μL catalysts were quickly added. The intensity of the absorption peak at 400 nm was monitored by UV-vis spectroscopy along with time. All the samples were thoroughly washed and purified by centrifugation before a next catalytic cycle.

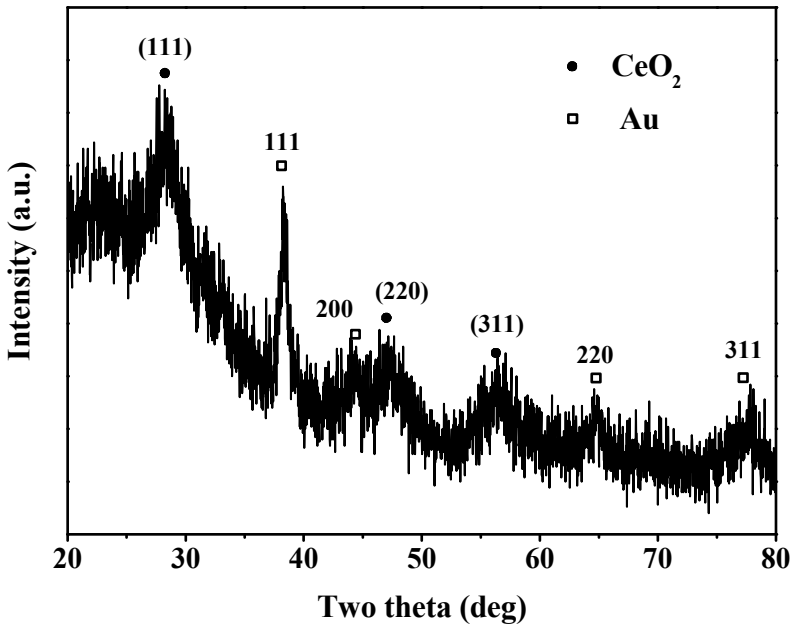

Figure S1. XRD pattern of the Au-CeO_2 nanosheets.

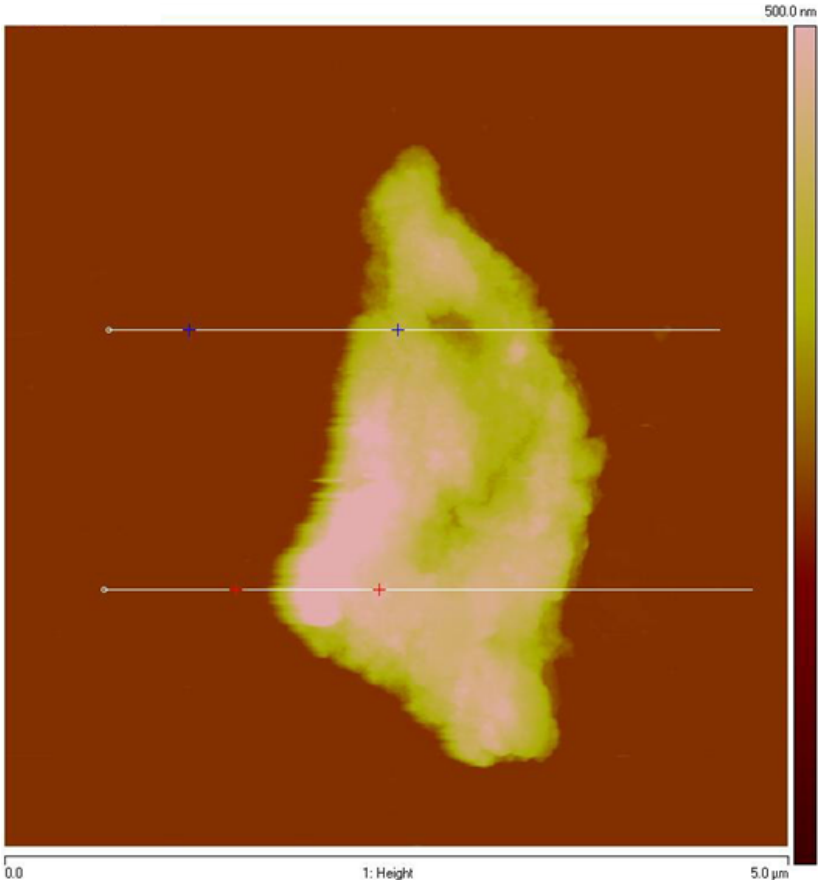

Figure. S2. AFM image of the Au-CeO_2 hybrid nanosheet.

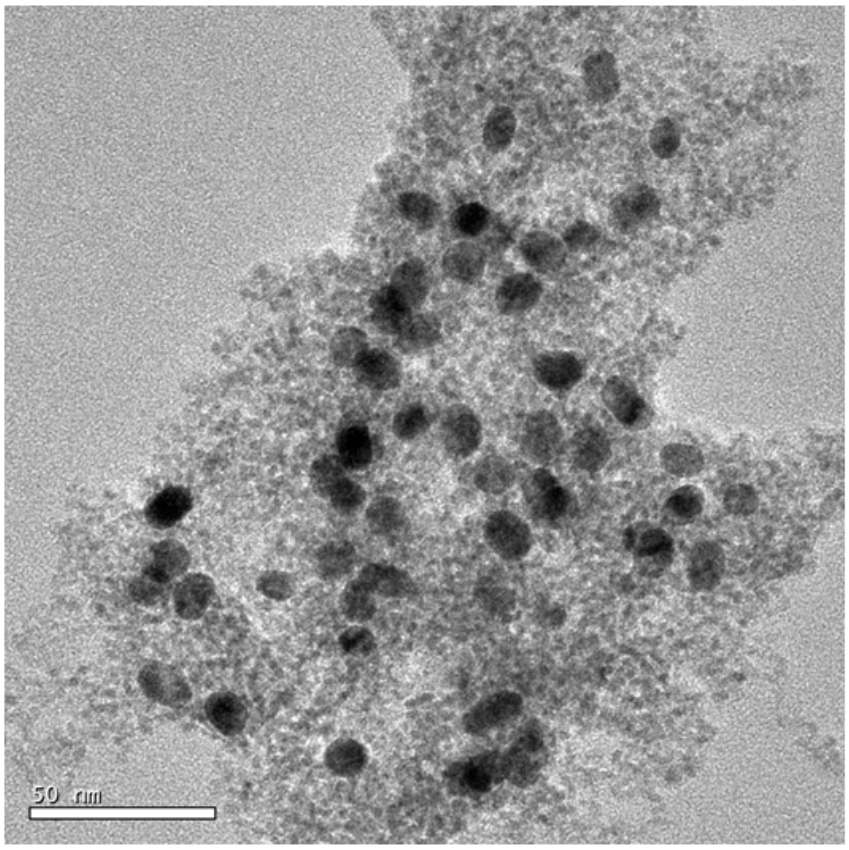

Figure S3. TEM image of the Au-CeO_2 nanohybrids obtained by adding 0.15 mmol $HAuCl_4$.

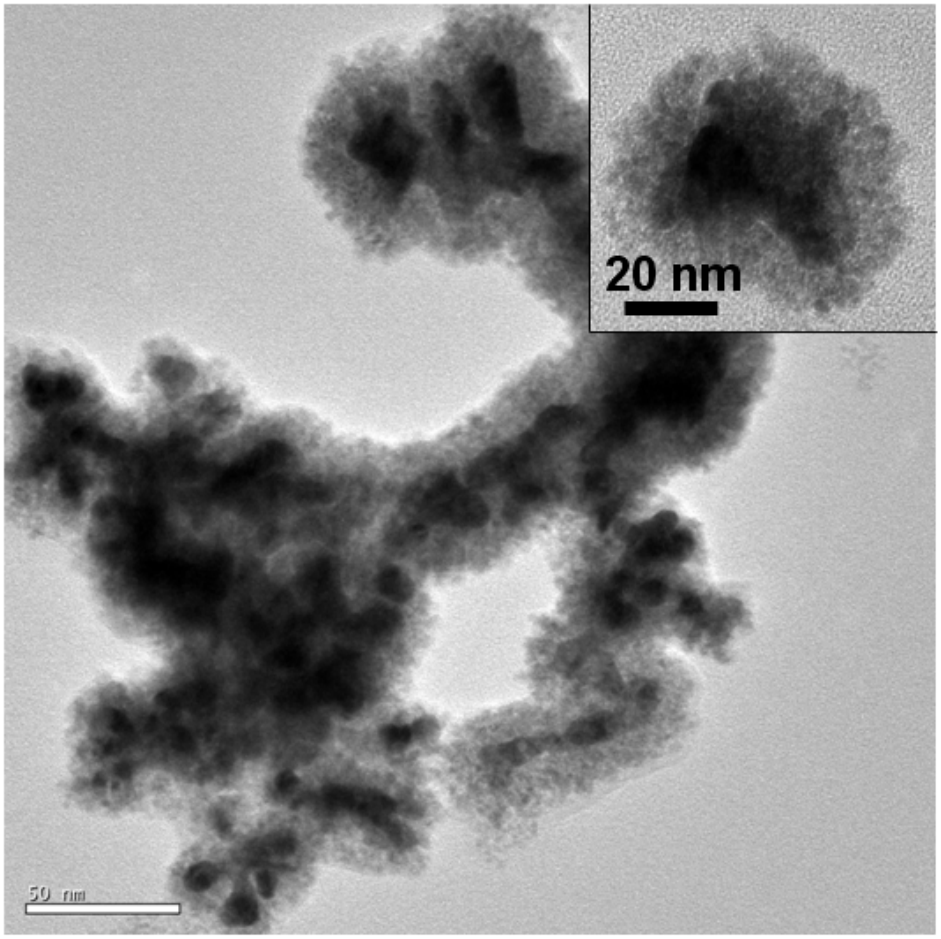

Figure S4. TEM images of the Au-CeO_2 nanohybrids without addition of PVP molecules.

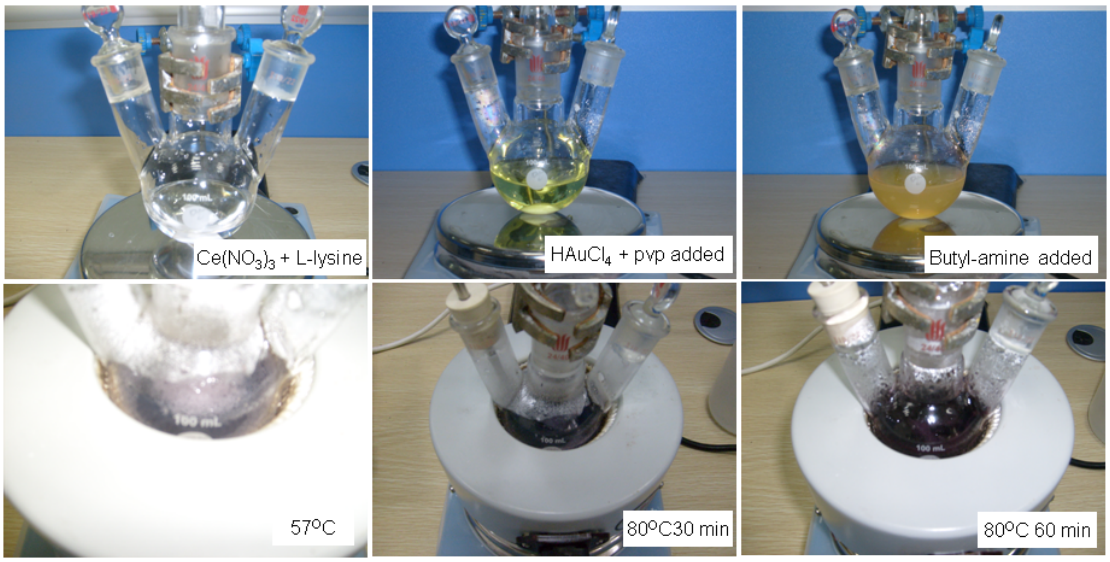

Figure S5. Photos of the color changes of the reaction system during the whole reaction progress.

Figure S6. Photo of the final hybrid nanosheet dispersed in water.

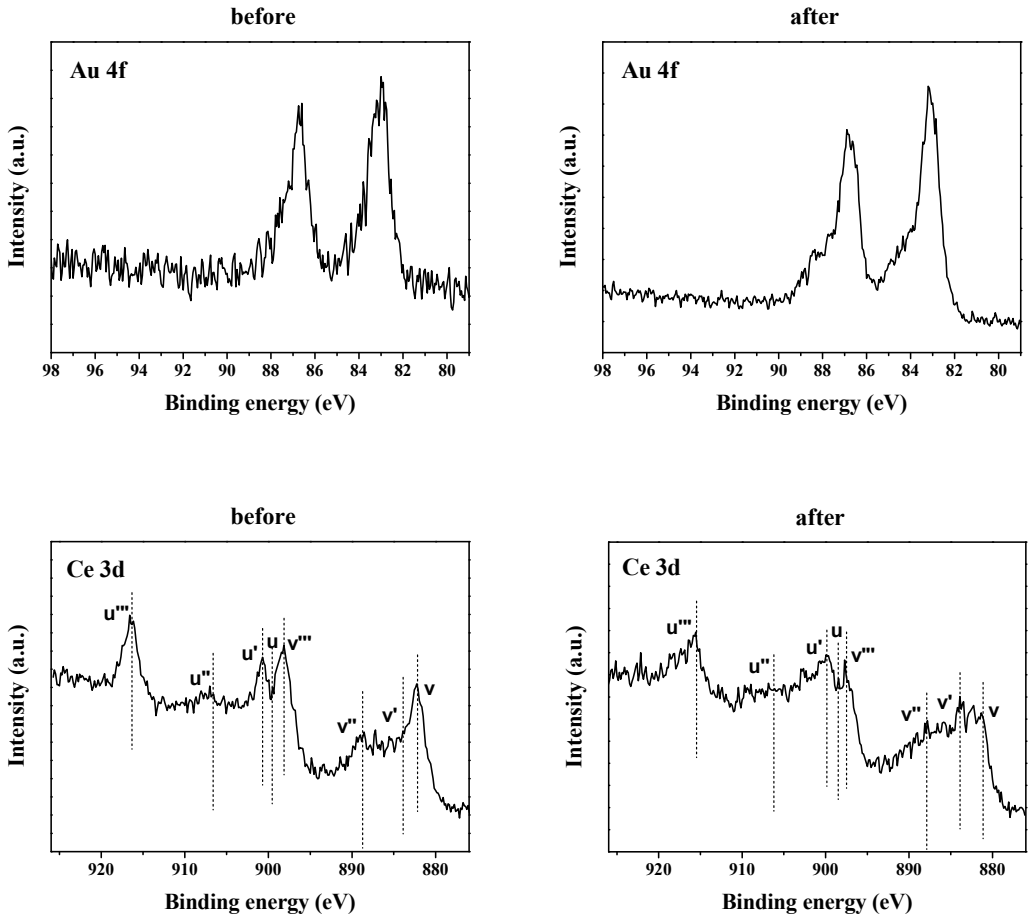

Figure S7. The observed peaks can be assigned for CeO_2 (Ce^{4+}) as v, v" and v"' for Ce $3d_{5/2}$, with the corresponding Ce $3d_{3/2}$ peaks labeled as u, u" and u"'. An additional doublet is also observed due to the presence of Ce_2O_3 (Ce^{3+}) and is assigned as v' and u'. Due to the presence of both Ce^{4+} and Ce^{3+}, it implies that cerium is present at the surface in both 4+ and 3+ oxidation states. After catalysis the relative intensity of the u' and v' annotated peaks increased, indicating an increase in the surface content of Ce^{3+}. Probably the Ce^{3+} has been formed due to the reduction of CeO_2 through catalysis.