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## Supporting Files

## The Band Structure and Photocatalytic Mechanism for CeO<sub>2</sub> Modified C<sub>3</sub>N<sub>4</sub>

## Photocatalyst

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Figure S1. XRD patterns of  $C_3N_4$ ,  $CeO_2$  and  $C_3N_4/CeO_2X\%$  samples.



Figure S2. FE-SEM images of (a)  $g-C_3N_4$ , (b) CeO<sub>2</sub>, and (c)  $C_3N_4$ /CeO<sub>2</sub>40%.

Figure S2 shows the FE-SEM images of pure  $g-C_3N_4$ , CeO<sub>2</sub> and C<sub>3</sub>N<sub>4</sub>/CeO<sub>2</sub>40% composite. It is revealed that  $g-C_3N_4$  displays a palte-like structure (Figure S2a). For CeO<sub>2</sub> sample, nanoparticles with average diameter of ~50 nm are observed (Figure S2b). For C<sub>3</sub>N<sub>4</sub>/CeO<sub>2</sub>40%, amounts of CeO<sub>2</sub> nanoparticles with an average diameter of about 200 nm are deposited and distributed on the surface of C<sub>3</sub>N<sub>4</sub> sheets, which results in forming a heterostructured CeO<sub>2</sub>/g-C<sub>3</sub>N<sub>4</sub> material.



Figure S3. UV–vis diffuse reflectance spectra for  $C_3N_4$ ,  $CeO_2$  and  $C_3N_4/CeO_2X\%$  samples



Figure S4. Photocatalytic activity for reduction of  $CO_2$  into  $CH_4$  (a) and CO (b) of  $C_3N_4$ ,  $CeO_2$ ,  $C_3N_4/CeO_2X\%$  samples.



Figure S5. XPS spectra of (a) C 1s for  $C_3N_4/CeO_240\%$  and  $C_3N_4$  samples, (b) N 1s for  $C_3N_4/CeO_240\%$  and  $C_3N_4$  samples, (c) O 1s for  $C_3N_4/CeO_240\%$ ,  $C_3N_4$  and  $CeO_2$  samples, (d) Ce 3d for  $C_3N_4/CeO_240\%$  and  $CeO_2$  samples



Figure S6. Photocatalytic activity of recycling experiments for  $g-C_3N_4/CeO_240\%$  with 5 times.