

Supplementary Information

1. X-Ray Diffraction

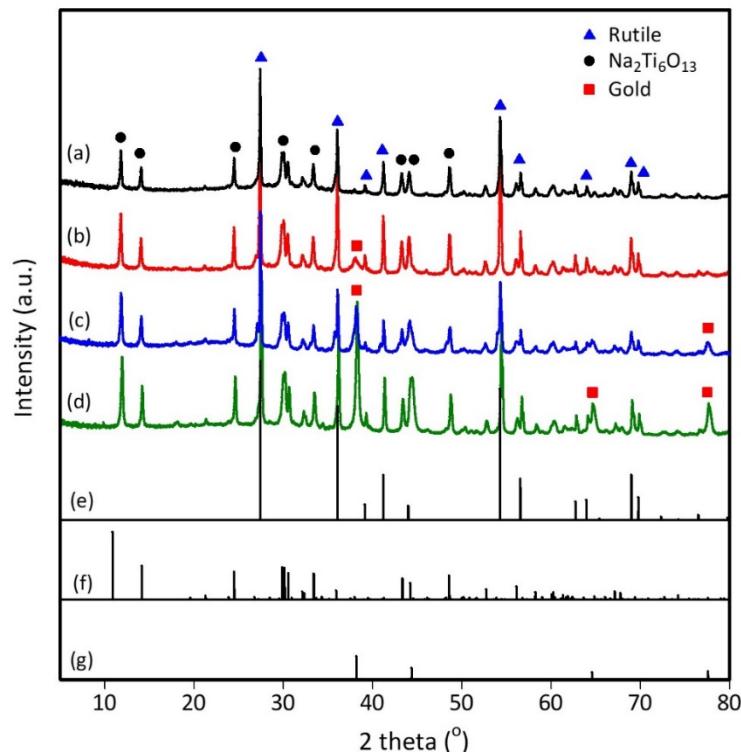


Figure S1. X-ray diffraction pattern (a) TiO_2/NTO , (b) 1% Au/ TiO_2/NTO , (c) 2% Au/ TiO_2/NTO , (d) 3% Au/ TiO_2/NTO , (e) rutile TiO_2 (ICSD 98-016-5920) [1], (f) $\text{Na}_2\text{Ti}_6\text{O}_{13}$ (NTO) (ICSD 98-016-3491) [2], and (g) gold (ICSD 98-008-2085) [3].

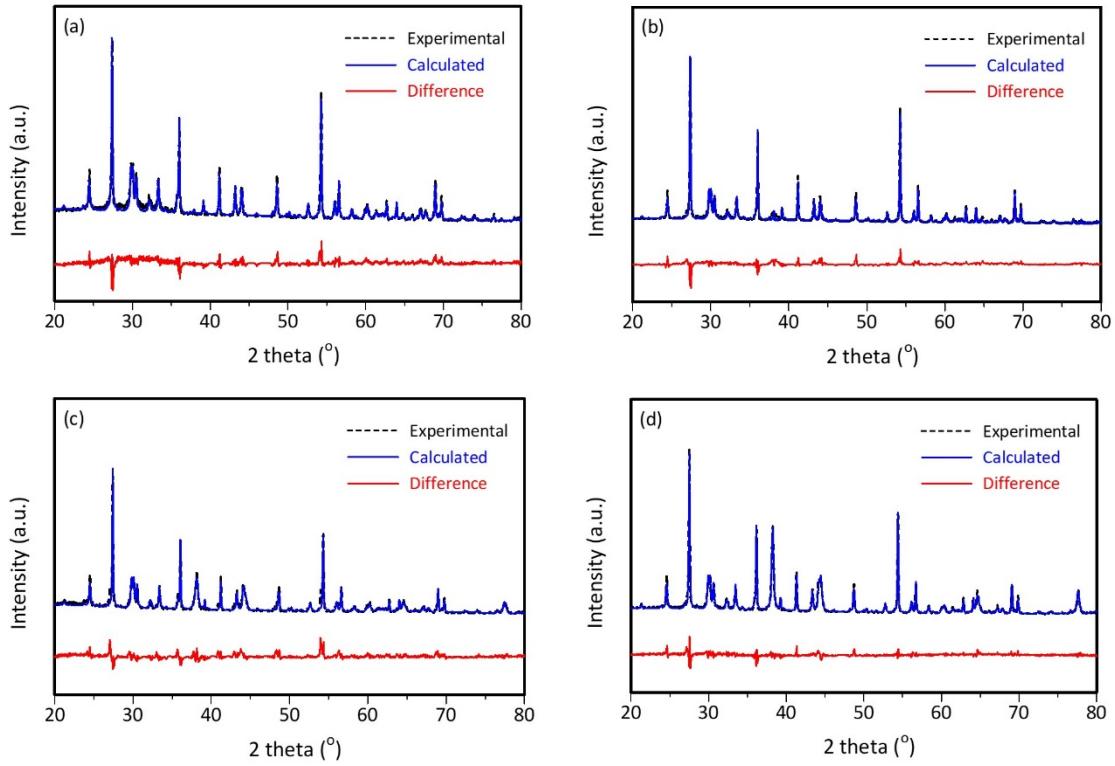


Figure S2. Rietveld refinement of XRD pattern of (a) TiO_2/NTO , (b) 1% $\text{Au}/\text{TiO}_2/\text{NTO}$, (c) 2% $\text{Au}/\text{TiO}_2/\text{NTO}$, and (d) 3% $\text{Au}/\text{TiO}_2/\text{NTO}$.

2. UV-Vis Spectroscopy

To determine the structure of Au formed, UV-vis spectroscopy analysis was performed on the catalyst. Figure S3 shows the absorption spectrum of gold with different oxidation states of 0 and +3. Au^{3+} indicated absorption patterns between 300-350 nm but no absorption in the 500-550 nm region. Meanwhile, at Au^0 , new absorption appeared in the area around 500-550 nm. The absorption results for Au^0 and Au^{3+} are consistent with Eustis et al. [4].

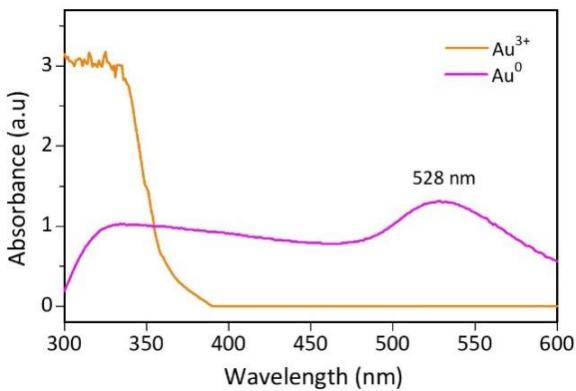


Figure S3. The UV-vis absorption spectrum of gold synthesis with HAuCl_4 precursor before (orange line) and after (pink line) the addition of NaBH_4 reducing agent.

Table S1. Bandgap energy values of the samples.

Sample	Wavelength (nm)	Eg/Bandgap energy (eV)
TiO ₂ /NTO	437	2.84
1% Au/TiO ₂ /NTO	443	2.80
2% Au/TiO ₂ /NTO	446	2.78
3% Au/TiO ₂ /NTO	479	2.59

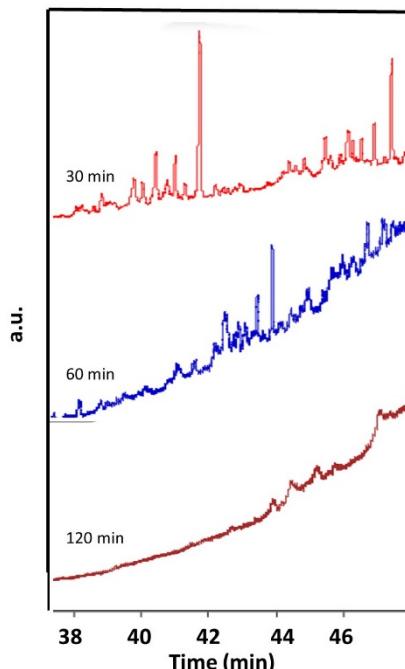


Figure S4. Chromatogram of phenol intermediate using GC-MS analysis.

References

1. Murugesan, S.; Kuppusami, P.; Mohandas. Rietveld X-ray diffraction analysis of nanostructured rutile films of titania prepared by pulsed laser deposition. *Mater. Res. Bull.* **2010**, *45*, 6-9.
2. Torres-Martínez, L.M.; Juárez-Ramírez, I.; Del Ángel-Sánchez, K.; Garza-Tovar, L.; Cruz-López, A.; Del Ángel, G. Rietveld refinement of sol-gel Na₂Ti₆O₁₃ and its photocatalytic performance on the degradation of methylene blue. *J. Solgel Sci. Technol.* **2008**, *47*, 158-164.
3. Tatge, E.; Swanson, H.E. Zeitschrift fuer Kristallographie, Kristallgeometrie, Kristallphysik. *Kristallchemie* **1956**, *107*, 357- 361.
4. Eustis, S.; Hsu, H.Y.; El-Sayed, M.A. Gold nanoparticle formation from photochemical reduction of Au³⁺ by continuous excitation in colloidal solutions. A proposed molecular mechanism. *J. Phys. Chem. B* **2005**, *109*, 4811-4815.