Supporting information for

Laser synthesis of gold/oxide nanocomposites

Feng Lin^a, Jing Yang^a, Su-Hong Lu^b, Kai-Yang Niu^a, Yuan Liu^b, Jin chang Jing^a, Sun^a, Xi-Wen Du^a^*

^a School of Materials Science and Engineering, Tianjin University, Tianjin, 300072, People’s Republic of China

^b School of Chemical Engineering and Technology, Tianjin University, Tianjin, 300072, People’s Republic of China

E-mail: xwdu@tju.edu.cn
Figure S1 XRD patterns of as-prepared GONs, (a) Au/TiO$_2$ (b) Au/Fe$_x$O$_y$. 
Figure S2 Size distribution of nanoparticles in GONs. (a) Au nanoparticles in Au/TiO$_2$ nanocomposite, (b) TiO$_2$ nanoparticles in Au/TiO$_2$ nanocomposite, (c) Au nanoparticles in Au/$\text{Fe}_x\text{O}_y$ nanocomposite, (d) $\text{Fe}_x\text{O}_y$ nanoparticles in Au/$\text{Fe}_x\text{O}_y$ nanocomposite.
Figure S3 SEM image of as-prepared Au/TiO$_2$ nanocomposite, where Au nanoparticles are marked by arrows.

Figure S4 High resolution TEM image corresponding to the inset of Figure 1b, where “T” indicates an edge dislocation.
Figure S5 XPS spectra of as-prepared Au/oxide nanocomposites. (a) Extended spectra of Au/Fe\textsubscript{x}O\textsubscript{y} (curve 1) and Au/TiO\textsubscript{2} (curve 2). (b) Au 4f spectra of Au/Fe\textsubscript{x}O\textsubscript{y} (curve 1) and Au/TiO\textsubscript{2} (curve 2). (c) Ti 2p spectrum of Au/TiO\textsubscript{2} and (d) Fe 2p spectrum of Au/Fe\textsubscript{x}O\textsubscript{y}.

**Detailed analysis on XPS spectra.** Quantified XPS results reveal that the atomic contents of Au are 2.7% and 3.0% for samples A and sample B, respectively. Cl 2p or Na 1s peak does not appear in Figure S4a,\textsuperscript{1} thus the washing procedure is an effective way to remove chloride ions which can lead to catalyst poisoning and agglomeration of Au nanocrystals.\textsuperscript{2}

For as-prepared Au/TiO\textsubscript{2} nanocomposite, the binding energies of Au 4f\textsubscript{7/2} and Au 4f\textsubscript{5/2} are 83.40 eV and 87.15 eV, respectively, while those for used Au/TiO\textsubscript{2} are 83.10 eV and 86.59 eV, respectively. Therefore, we conclude that Au atoms are in metallic state, and the reason why the binding energy of Au 4f\textsubscript{7/2} is lower than that for bulk gold (84.0 eV) should be attributed to surface core level shift and charge transfer from TiO\textsubscript{2} to Au nanoparticles.\textsuperscript{3} Moreover, XPS results show that the binding energy of O
1s in Au/TiO$_2$ is 530 eV, thereby, Ti atoms are fully oxidized into TiO$_2$.\textsuperscript{4}

For Au/Fe$_x$O$_y$ nanocomposite, the binding energies of Au 4f$_{7/2}$ and Au 4f$_{5/2}$ are 83.56 eV and 87.31 eV, respectively, and the binding energies of Fe 2p$_{1/2}$ and Fe 2p$_{3/2}$ are 724.81 eV and 710.56 eV, respectively. Particularly, a satellite line is found situated at 719.55 eV, which is the characteristic of Fe$^{3+}$ in $\gamma$-Fe$_2$O$_3$.\textsuperscript{5,6} Hence, the surface of Fe$_x$O$_y$ nanoparticles is composed of $\gamma$-Fe$_2$O$_3$.

**Figure S6** TEM images of Au/TiO$_2$ nanocomposite after three catalytic cycles. (a) Low magnification image and (b) high magnification image.

**Figure S7** XPS spectra of Au/TiO$_2$ nanocomposites after three catalytic cycles. (a) Ti 2p spectrum. (b) Au 4f spectrum.
References


