Supporting Information

# The crystalline/amorphous stacking structure of $SnO_2$ microspheres for the excellent NO photocatalytic performance

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To understand the formation of oxygen vacancy, XPS was carried out to determine the element surface chemical compositions and valence states of different $SnO_2$ samples. From the XPS survey spectra, O, Sn and C elements can be observed in all samples. As indicated in Figure 6, the O content first decreases as increases reaction time to 6h and increases when further increasing reaction time. The Sn and O element contents of all samples were listed in Table 1.With increasing the reaction time, the O contents in$SnO_2$-3h, $SnO_2$-6h, $SnO_2$-9h, $SnO_2$-12h samples are 67.33 %, 51.99 %, 58.84 %, and 64.51 % and the corresponding chemical compositions are calculated to $SnO_{2.06}$, $SnO_{1.08}$, $SnO_{1.43}$ and $SnO_{1.82}$, respectively. The $SnO_2$-6h sample contains minimum O content, which implies most oxygen vacancies in contrast to other samples. The results are consistent with the above EPR results. In addition, the high resolution Sn3d XPS spectra of different samples were also analysed in Figure 5. The spectra of Sn3d in all samples are made up of two characteristic peaks at around 486.8 and 495.3 eV, corresponding to $Sn3d_{5/2}$ and $Sn3d_{3/2}$ peaks of $Sn^{4+}$. However, these two peaks in $SnO_2$-6h shift towards higher energy states with ~ 0.4-0.5 eV. This may be associated to the oxygen vacancy inducing the reduction of the electronic density around Sn atom.

**Table S1.** Elemental analyses of the $SnO_2$ materials

| sample | Sn(%) | O(%) | O/Sn ratio |
|---|---|---|---|
| $SnO_2$-3h | 32.67 | 67.33 | 2.06 |
| $SnO_2$-6h | 48.01 | 51.99 | 1.08 |
| $SnO_2$-9h | 41.16 | 58.84 | 1.43 |
| $SnO_2$-12h | 35.49 | 64.51 | 1.82 |

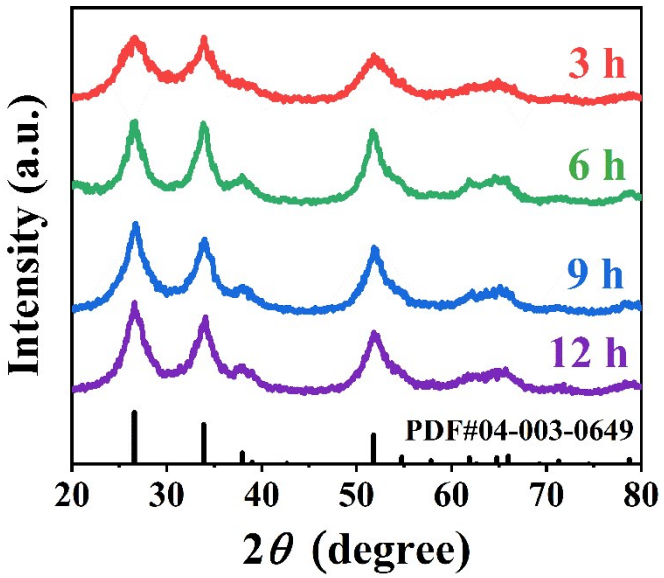


**Figure S1.** XRD patterns of all samples

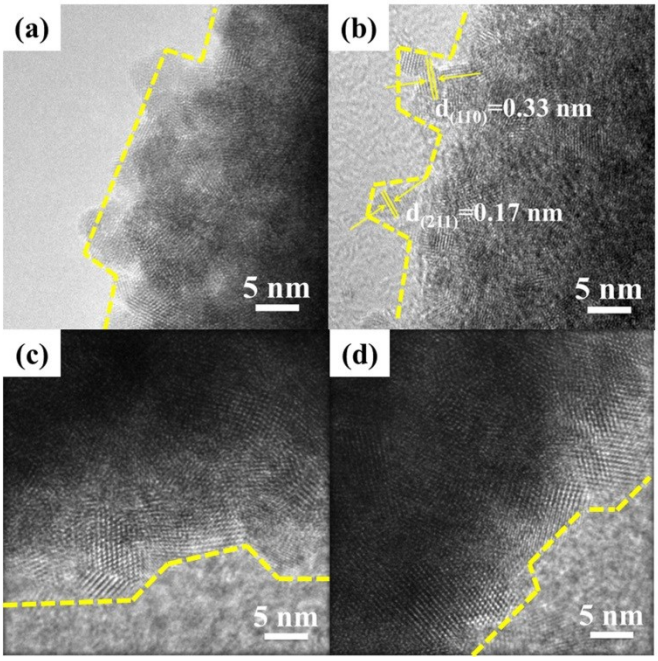


**Figure S2.** HRTEM images of as synthesized samples.

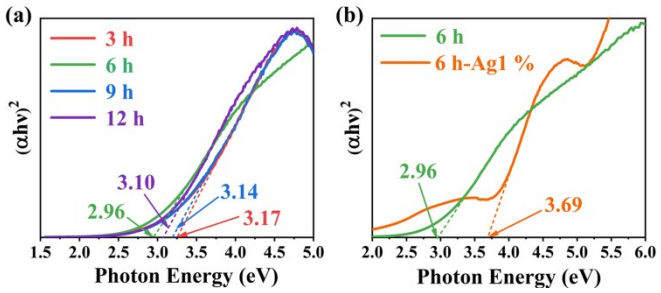


**Figure S3.** (a)Tauc plots of $SnO_2$ samples; (b) Tauc plots ofthe $SnO_2$-Ag1% and $SnO_2$-6h samples. The plot of $(\alpha hv)^2$ vs $hv$ is presented in Figure based onthe equation of $(\alpha hv)^n$ = A ($hv$-$Eg$), where $\alpha$, $h$, $v$ and $A$ are the absorption coefficient, Planck constant, frequency and constant, respectively.

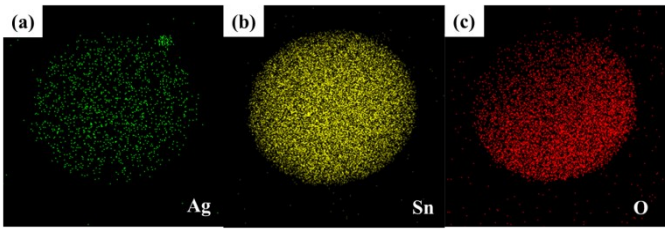


**Figure S4.** Elemental mapping of 1% Ag coated $SnO_2$-6h sample.