

Supporting Information

**A Facile Exfoliation–Crystal Growth Route to Multicomponent
Ag₂CO₃/Ag–Ti₅NbO₁₄ Nanohybrids with Improved Visible Light
Photocatalytic Activity**

Suhye Park, Jang Mee Lee, Yun Kyung Jo, In Young Kim, and Seong-Ju Hwang*

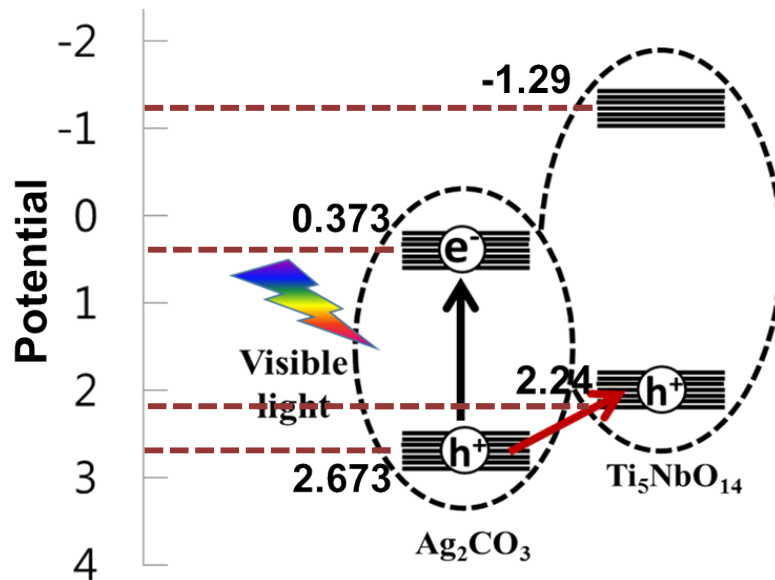
*Department of Chemistry and Nano Sciences, College of Natural Sciences, Ewha Womans University, Seoul
120-750, Korea*

Table S1. Results of deconvolution analysis for Ag 3d XPS spectra of the Ag₂CO₃/Ag–Ti₅NbO₁₄ nanohybrids.

| Oxidation state | AT1 | | AT2 | |
|-----------------|---------|----------|---------|----------|
| | BE (eV) | Area (%) | BE (eV) | Area (%) |
| Ag ⁰ | 368.20 | 27.6 | 368.18 | 33.3 |
| Ag ⁺ | 367.77 | 72.4 | 367.78 | 66.7 |

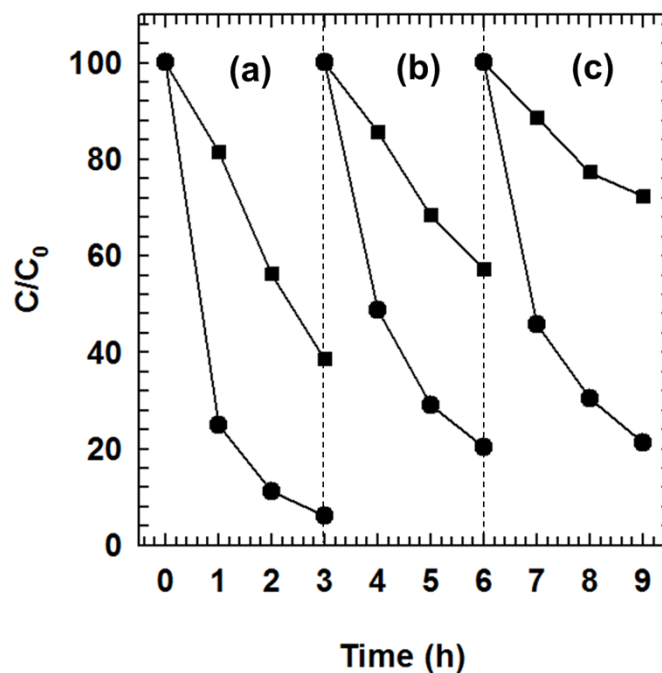
: The Ag 3d XPS spectra of the present Ag₂CO₃/Ag–Ti₅NbO₁₄ nanohybrids can be commonly resolved into two components corresponding to monovalent Ag⁺ cation and neutral Ag⁰ element. **Table S1** summarizes the components of silver species. According to the peak convolution analysis, the observed XPS spectra of the present **AT** nanohybrids are well-reproduced with the summation of the spectra of Ag₂CO₃ and Ag metal, indicating the presence of these two phases. The ratio of Ag metal/Ag₂CO₃ is determined to be 0.38 and 0.50 for the **AT1** and **AT2** nanohybrids, suggesting the increase of Ag metal upon the increase of Ag content.

Fig. S1. Schematic model for the electronic structure of the $\text{Ag}_2\text{CO}_3/\text{Ag}-\text{Ti}_5\text{NbO}_{14}$ nano hybrids.



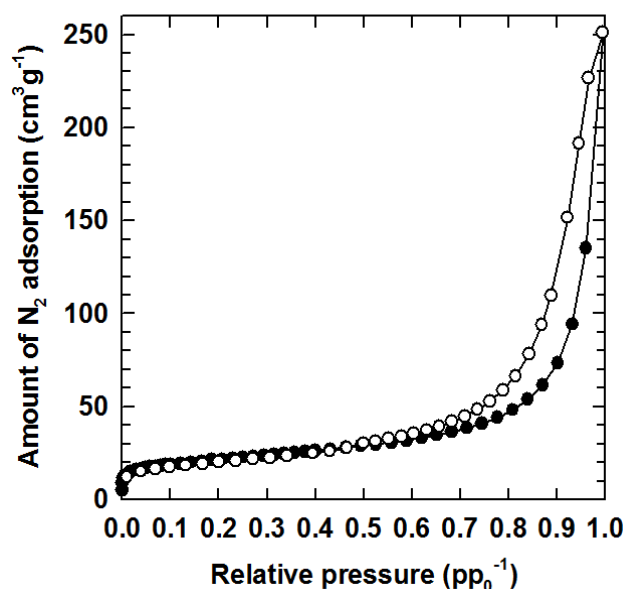
: As plotted in **Fig. S1**, taking into account the relative band positions of titanoniobate and silver carbonate, photoinduced holes in the valence band (VB) of Ag_2CO_3 can be transferred into the upper-lying VB of $\text{Ti}_5\text{NbO}_{14}$, leading to the spatial separation of electrons and holes and the increase of their lifetime. The presence of minor metallic silver phase is believed to promote the electron transfer between Ag_2CO_3 and $\text{Ti}_5\text{NbO}_{14}$.

Fig. S2. Three successive photocatalyst test for visible light ($\lambda > 420$ nm)-induced degradation of 4-CP molecule by the **AT2** nano hybrid (circle) and the unhybridized Ag_2CO_3 (square) for (a) the 1st cycle, (b) the 2nd cycle, and (c) the 3rd cycle.



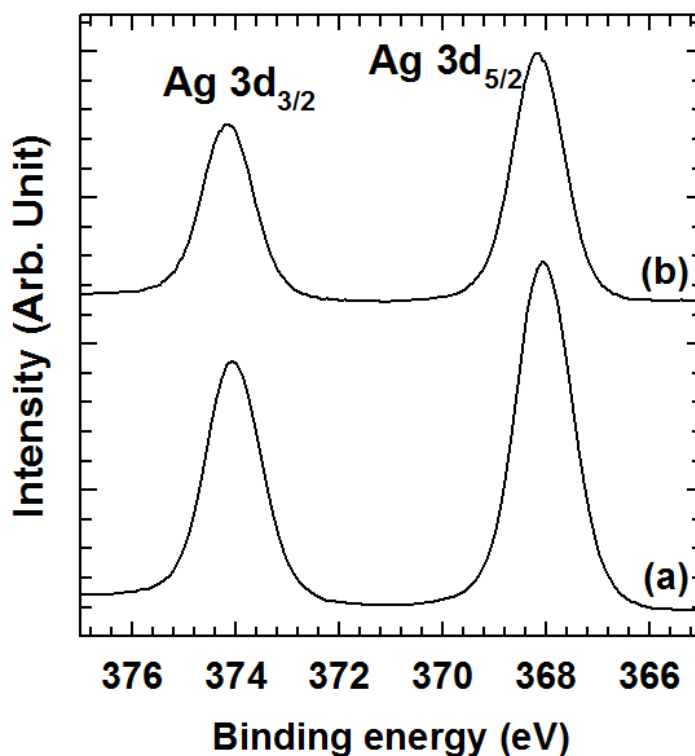
: To probe the photostability of the present $\text{Ag}_2\text{CO}_3/\text{Ag-Ti}_5\text{NbO}_{14}$ nano hybrids, the photocatalytic performance of the **AT2** nano hybrid is repeatedly examined for consecutive three cycles. As illustrated in **Fig. S2**, the depression of photocatalytic activity for the degradation of 4-CP is much weaker for the **AT2** nano hybrid (~85% retention after the 3rd cycle) than for Ag_2CO_3 (~45% retention after the 3rd cycle), confirming the positive effect of hybridization on the photostability of silver carbonate.

Fig. S3. N₂ adsorption–desorption isotherms of the **AT2** nanohybrid subjected to the photocatalyst test under the illumination of visible light ($\lambda > 420$ nm). The close and open symbols represent the adsorption and desorption data, respectively.



: As illustrated in **Fig. S3**, the surface area of the **AT2** nanohybrid subjected to the photocatalyst test is determined to be ~ 70 m²g⁻¹, which is quite similar to that of the as-prepared **AT2** nanohybrid. This result clearly demonstrates the maintenance of the porous structure of the Ag₂CO₃/Ag–Ti₅NbO₁₄ nanohybrid.

Fig. S4. Ag 3d XPS spectra of the **AT2** nanohybrid (a) before and (b) after the photocatalyst test under the illumination of visible light ($\lambda > 420$ nm).



: As plotted in **Fig. S4**, the photocatalyst test induces only a weak variation in Ag 3d XPS spectra of the **AT2** nanohybrid. This result clearly demonstrates the maintenance of the chemical nature of silver species (Ag_2CO_3 and Ag metal) in the $\text{Ag}_2\text{CO}_3/\text{Ag-Ti}_5\text{NbO}_{14}$ nanohybrid. The deconvolution analysis for the present XPS spectra demonstrates that the ratio of Ag^0/Ag^+ shows only a slight increase from 0.50 to 0.52 upon the photocatalyst test, underscoring the weak influence of photoreaction on the chemical bonding nature of silver species.