*Supplementary Materials*

# Photocatalysis: A Possible Vital Contributor to the Evolution of the Prebiotic Atmosphere and the Warming of the Early Earth

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# Figures

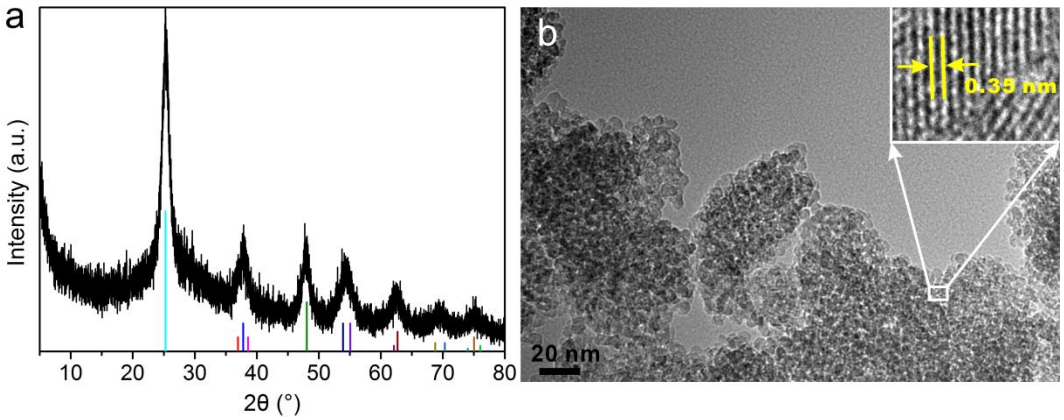


**Figure S1.** (**a**) XRD pattern of $TiO_2$ and JCPDS standard card (21-1272) [1]; (**b**) TEM image of $TiO_2$. (Inset shows the HRTEM of $TiO_2$, where lattice fringes with a spacing of 0.35 nm correspond to the (101) plane of $TiO_2$ [2].)

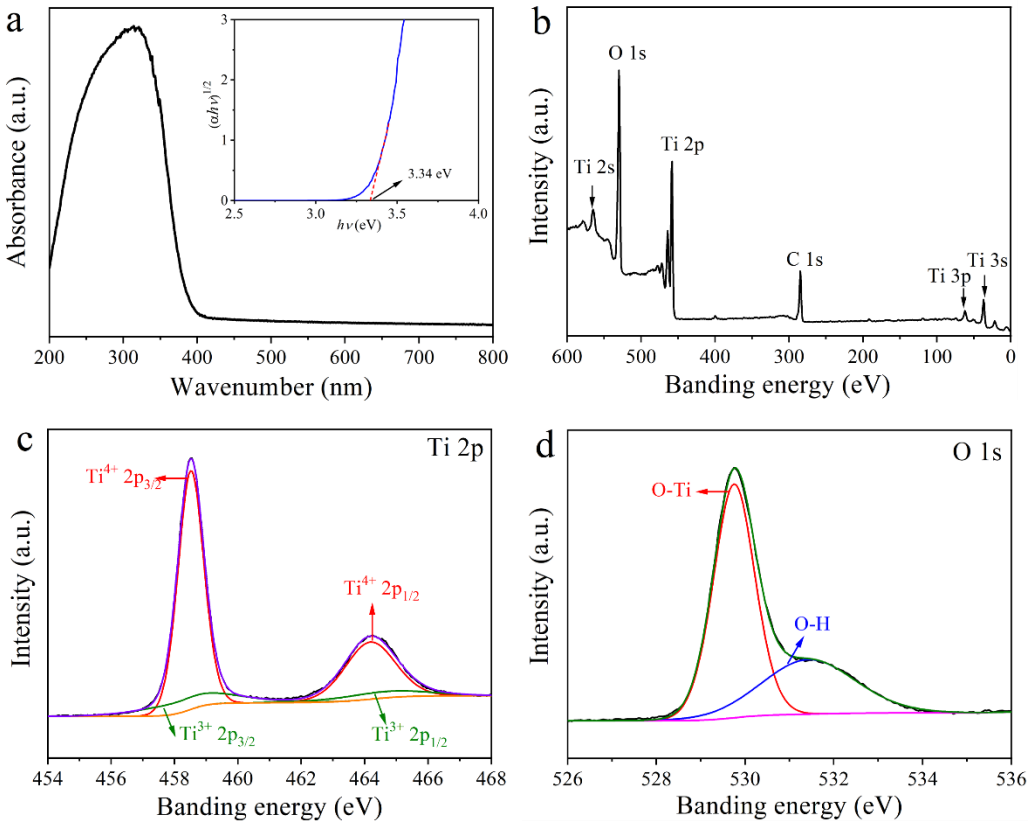


**Figure S2.** (**a**) UV-Vis diffusion reflectance spectrum (DRS) of $TiO_2$. (Inset: a value of 3.34 eV was observed read for the band gap of $TiO_2$ between the $(F(R)hv)^{1/2}$ and E plots.); (**b**) XPS survey of commercial $TiO_2$ [3]; (**c**) Ti 2p lines and fit. The peak at 458.6 eV fits to $Ti^{4+}$, which is attributed to Ti-O in the $TiO_2$ [4]; (**d**) O 1s lines and fit.

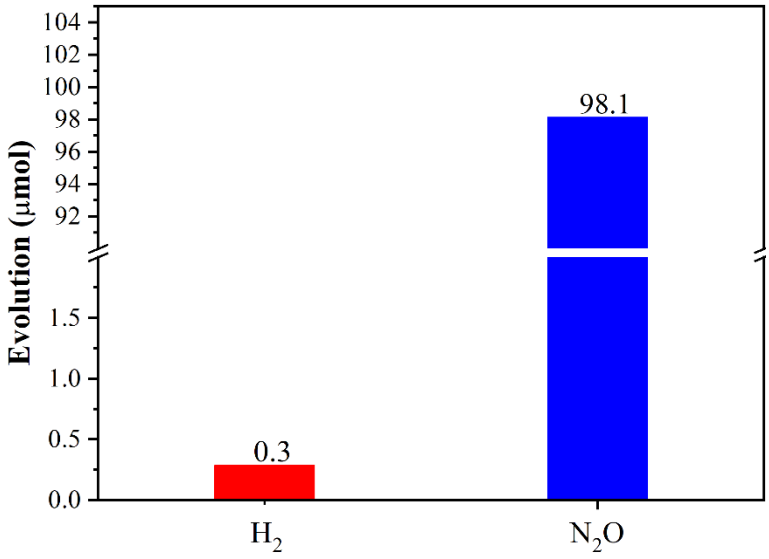


**Figure S3.** The production of $H_2$ and $N_2O$ with $TiO_2$ and light after 5 days illumination.

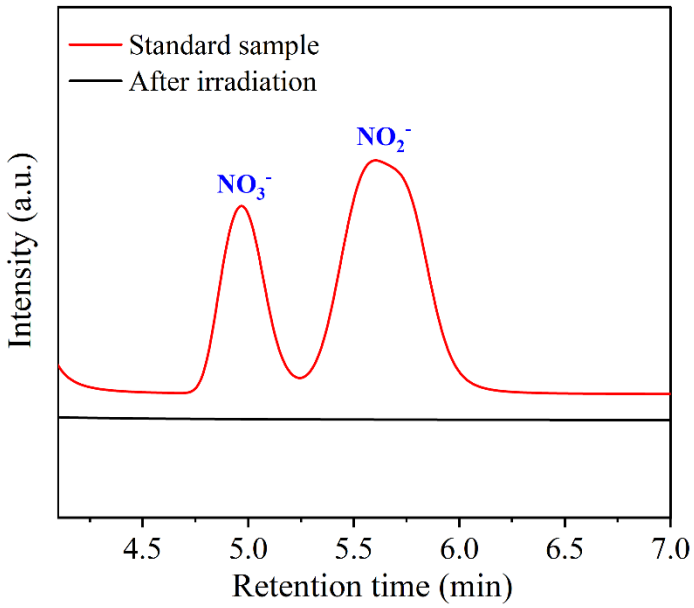


**Figure S4.** Comparison of the reaction liquid ion chromatogram after irradiation (black line) and standard ion chromatogram (red line) of $NO_3^-$ and $NO_2^-$.

# Reference


1. Yang, H.G., C.H. Sun, S.Z. Qiao, J. Zou, G. Liu, S.C. Smith, H.M. Cheng, and G.Q. Lu Anatase $TiO_2$ single crystals with a large percentage of reactive facets. *Nature* **2008**, *453*, 638-641.
2. Wang, W.K., J.J. Chen, X. Zhang, Y.X. Huang, W.W. Li, and H.Q. Yu Self-induced synthesis of phase-junction $TiO_2$ with a tailored rutile to anatase ratio below phase transition temperature. *Scientific Reports* **2016**, *6*, 20491.
3. Yu, Y., W. Wen, X.Y. Qian, J.B. Liu, and J.M. Wu UV and visible light photocatalytic activity of Au/$TiO_2$ nanoforests with Anatase/Rutile phase junctions and controlled Au locations. *Scientific Reports* **2017**, *7*, 41253.
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