

## Electronic Supplementary Information

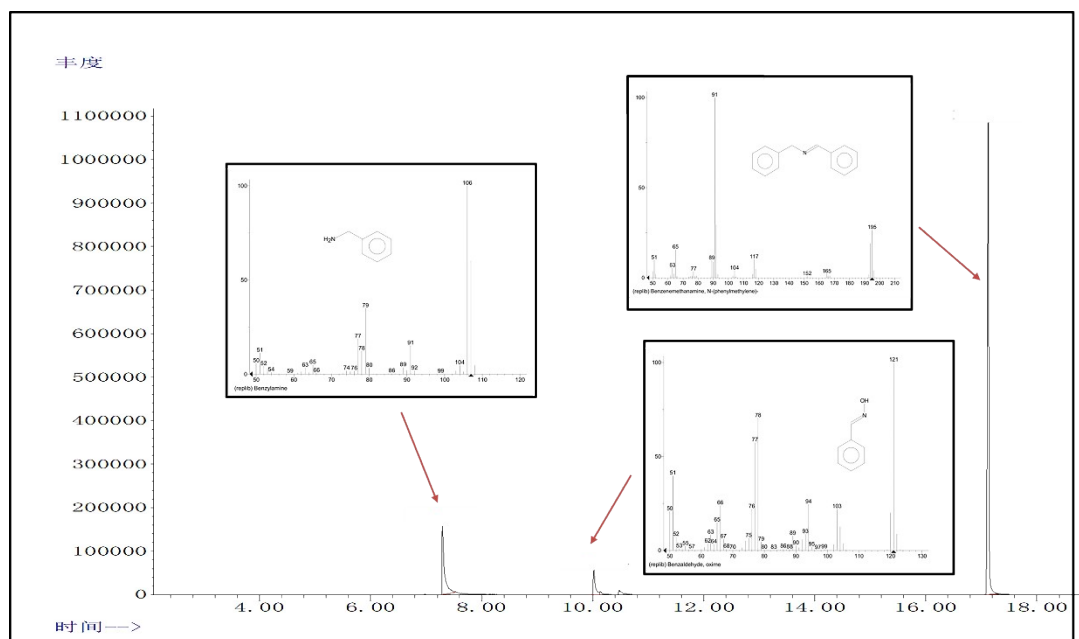
### **Au/TiO<sub>2</sub> nanobelts: Thermal enhancement vs plasmon enhancement for visible-light-driven photocatalytic selective oxidation of amines into imines**

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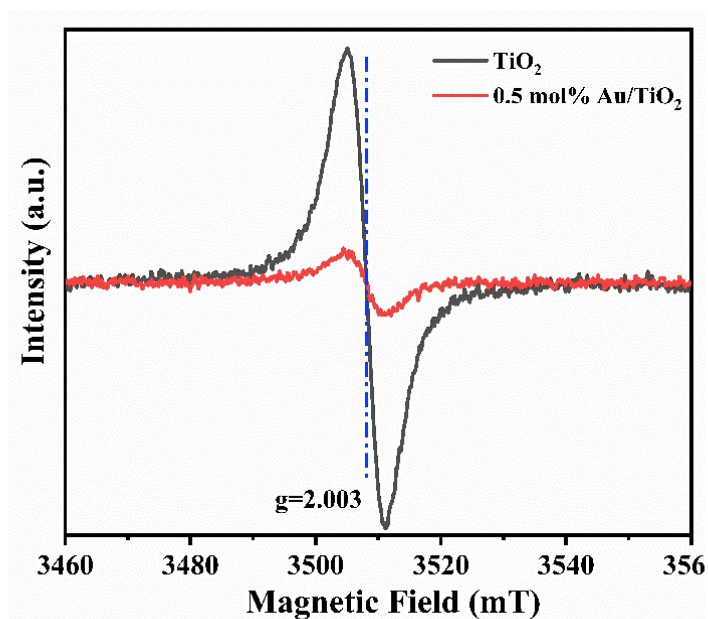
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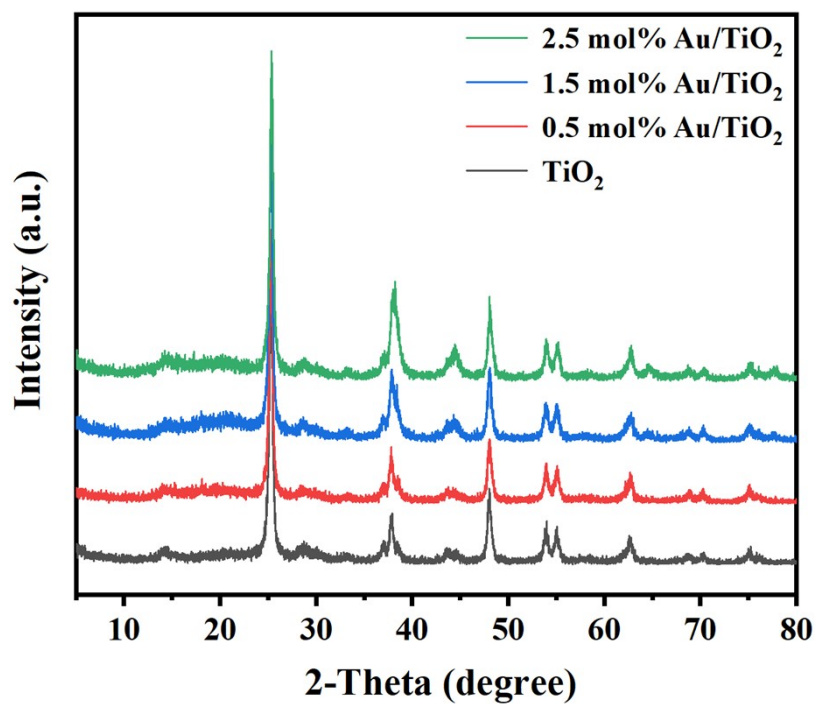
<sup>‡</sup> These authors contributed equally to this work.



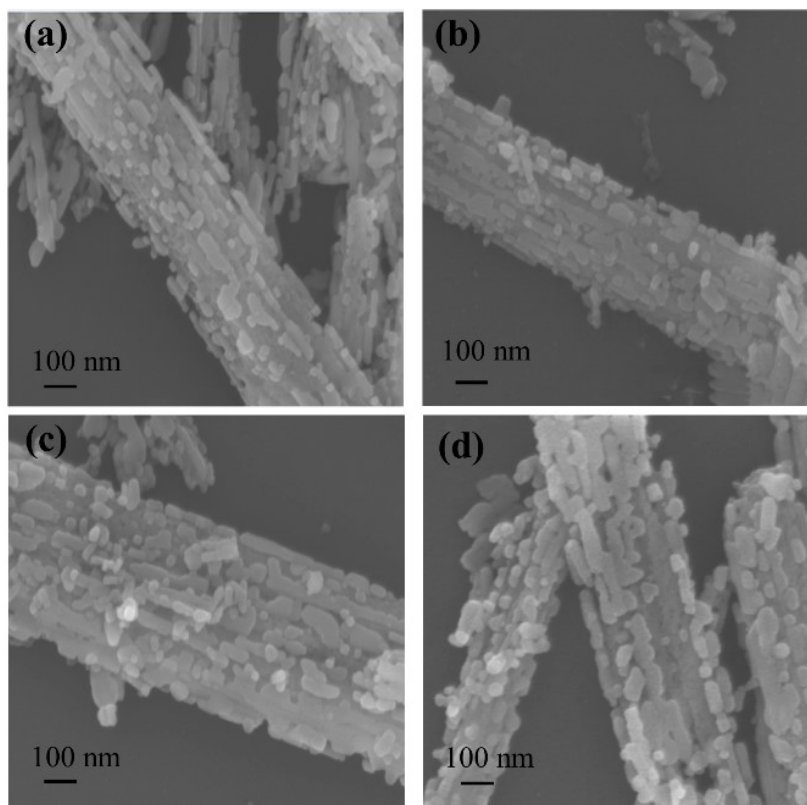
**Figure S1.** The GC-MS analysis of supernatant using 0.5 mol% Au/TiO<sub>2</sub> as photocatalyst for photocatalytic oxidation of benzylamine.



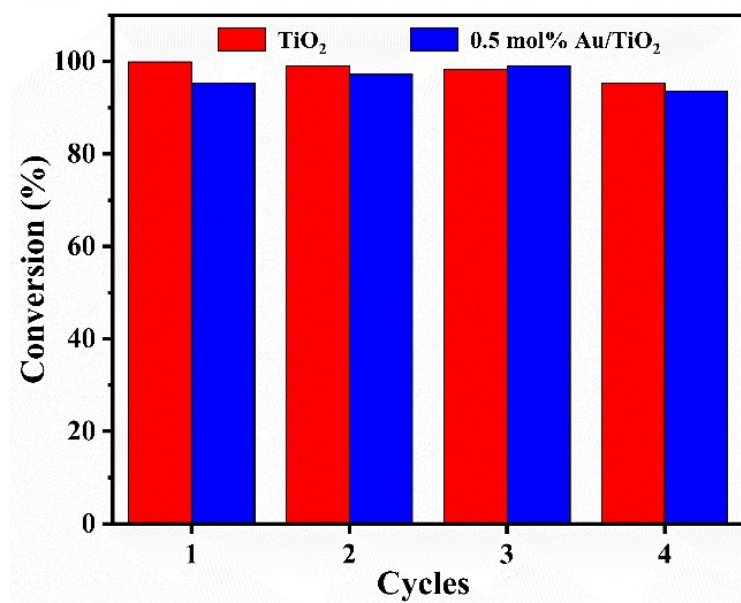
**Figure S2.** ESR spectrum of TiO<sub>2</sub> and 0.5 mol% Au/TiO<sub>2</sub> at room temperature.



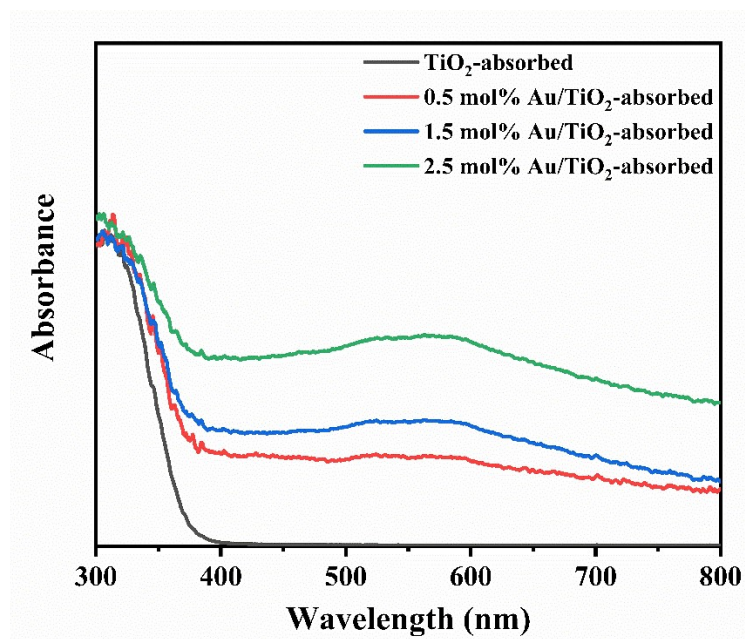
**Figure S3.** XRD patterns of as-prepared samples after the recycling experiment .



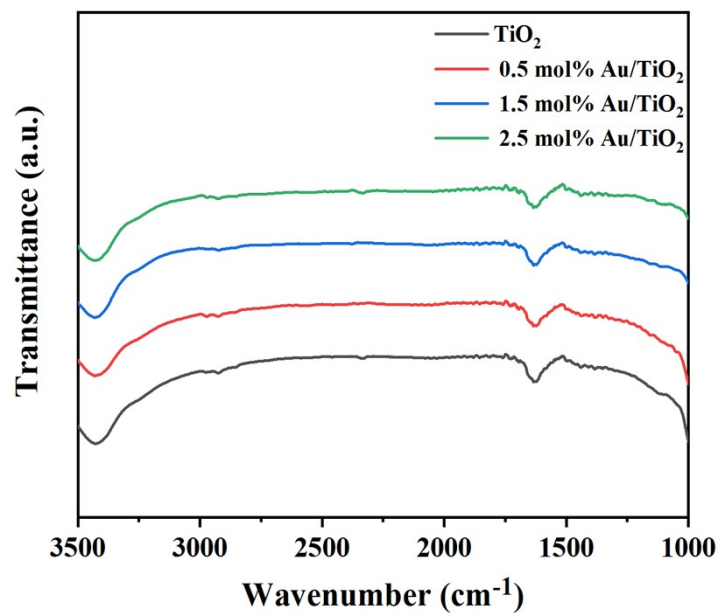
**Figure S4.** SEM images of (a) TiO<sub>2</sub> nanobelts; (b) 0.5 mol% Au-TiO<sub>2</sub> ;(c) 1.5 mol% Au-TiO<sub>2</sub> samples; (d) 2.5 mol% Au-TiO<sub>2</sub> samples after cycle experiments.



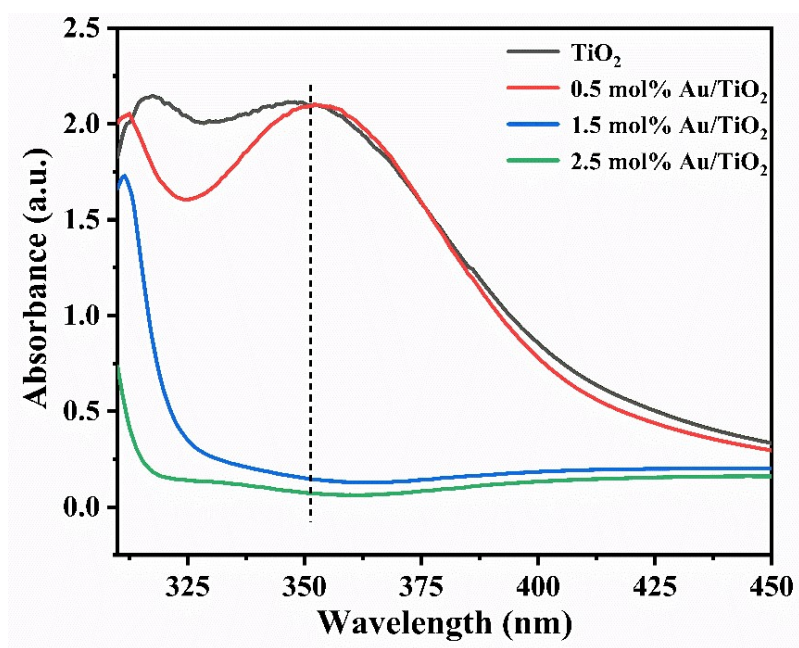
**Figure S5.** The recyclability of TiO<sub>2</sub> and 0.5 mol% Au/TiO<sub>2</sub> catalyst in the photocatalytic oxidation of benzylamine at 60 °C, 12 h.



**Figure S6.** UV-vis adsorption spectra of the corresponding benzylamine-adsorbed catalyst.



**Figure S7.** FT-IR image of  $\text{TiO}_2$  and 0.5, 1.5, 2.5 mol%  $\text{Au-TiO}_2$  nanobelts.



**Figure S8.** The corresponding UV-vis absorption spectra for detecting  $\text{H}_2\text{O}_2$  produced in the reaction suspensions for as-prepared samples.

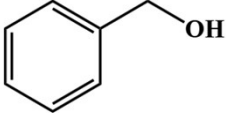
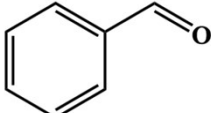
**Table S1.** ICP tests of Au/TiO<sub>2</sub> catalyst

| Sample name                  | Weight percent of Au | Actual test value | Theoretical value |
|------------------------------|----------------------|-------------------|-------------------|
| 0.5 mol% Au/TiO <sub>2</sub> | 1.50wt%              | 0.6 mol%          | 0.5 mol%          |
| 1.5 mol% Au/TiO <sub>2</sub> | 4.36wt%              | 1.7 mol%          | 1.5 mol%          |
| 2.5 mol% Au/TiO <sub>2</sub> | 7.39wt%              | 3.0 mol%          | 2.5 mol%          |

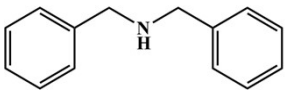
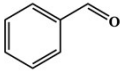
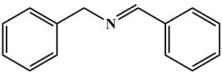
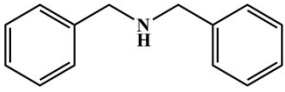
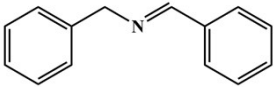
**Table S2.** XPS peak details for different catalysts

| Catalyst                          | Ti 2p (eV) | Assignments                        | O 1s (eV) | Assignments             | Peak area | Au 4f (eV) | Assignments          |
|-----------------------------------|------------|------------------------------------|-----------|-------------------------|-----------|------------|----------------------|
| TiO <sub>2</sub>                  | 458.9      | Ti <sup>4+</sup> 2p <sub>3/2</sub> | 530.2     | Lattice oxygen          | 54.6%     | \          | \                    |
|                                   |            |                                    | 530.5     | Oxygen vacancy          | 24.1%     |            |                      |
|                                   | 464.6      | Ti <sup>4+</sup> 2p <sub>1/2</sub> | 532.1     | Surface absorbed oxygen | 21.3%     |            |                      |
| 0.5 Au/TiO <sub>2</sub>           | 459.0      | Ti <sup>4+</sup> 2p <sub>3/2</sub> | 530.2     | Lattice oxygen          | 60.0%     | 83.5       | Au 4f <sub>7/2</sub> |
|                                   |            |                                    | 530.5     | Oxygen vacancy          | 21.0%     |            |                      |
|                                   | 464.7      | Ti <sup>4+</sup> 2p <sub>1/2</sub> | 532.3     | Surface absorbed oxygen | 19.0%     | 87.1       | Au 4f <sub>5/2</sub> |
| 1.5 Au/TiO <sub>2</sub>           | 459.0      | Ti <sup>4+</sup> 2p <sub>3/2</sub> | 530.2     | Lattice oxygen          | 67.4%     | 83.5       | Au 4f <sub>7/2</sub> |
|                                   |            |                                    | 530.5     | Oxygen vacancy          | 17.1%     |            |                      |
|                                   | 464.7      | Ti <sup>4+</sup> 2p <sub>1/2</sub> | 532.2     | Surface absorbed oxygen | 15.5%     | 87.1       | Au 4f <sub>5/2</sub> |
| 2.5 Au/TiO <sub>2</sub>           | 459.0      | Ti <sup>4+</sup> 2p <sub>3/2</sub> | 530.2     | Lattice oxygen          | 70.3%     | 83.5       | Au 4f <sub>7/2</sub> |
|                                   |            |                                    | 530.5     | Oxygen vacancy          | 14.5%     |            |                      |
|                                   | 464.7      | Ti <sup>4+</sup> 2p <sub>1/2</sub> | 532.2     | Surface absorbed oxygen | 15.2%     | 87.1       | Au 4f <sub>5/2</sub> |
| TiO <sub>2</sub> -absorbed        | 458.7      | Ti <sup>4+</sup> 2p <sub>3/2</sub> | 529.9     | Lattice oxygen          | 30.5%     | \          | \                    |
|                                   | 464.4      | Ti <sup>4+</sup> 2p <sub>1/2</sub> | 532.0     | Surface absorbed oxygen | 69.5%     |            |                      |
| 0.5 Au/TiO <sub>2</sub> -absorbed | 458.7      | Ti <sup>4+</sup> 2p <sub>3/2</sub> | 529.8     | Lattice oxygen          | 53.6%     | 83.8       | Au 4f <sub>7/2</sub> |
|                                   |            |                                    | 530.3     | Oxygen vacancy          | 22.2%     |            |                      |
|                                   | 464.3      | Ti <sup>4+</sup> 2p <sub>1/2</sub> | 532.1     | Surface absorbed oxygen | 24.2%     | 87.4       | Au 4f <sub>5/2</sub> |

**Table S3.** Activity of TiO<sub>2</sub> and M-Au/TiO<sub>2</sub> Catalysts in oxidation of Benzyl Alcohol into Benzaldehyde

| <div style="display: flex; align-items: center; justify-content: space-around;"> <div style="text-align: center;">  </div> <div style="text-align: center;"> <math>\xrightarrow[\text{10 mg catalyst, 0.25 mmol benzyl alcohol, 5 ml CH}_3\text{CN}]{\text{Visible light (&gt;420 nm), 1 atm O}_2, 20 \text{ h}}</math> </div> <div style="text-align: center;">  </div> </div> |                  |                              |                              |                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------|------------------------------|------------------------------|
| Temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | TiO <sub>2</sub> | 0.5 mol% Au-TiO <sub>2</sub> | 1.5 mol% Au-TiO <sub>2</sub> | 2.5 mol% Au-TiO <sub>2</sub> |
| 20 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9.2              | 16.4                         | 19.2                         | 22.6                         |
| 60 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 20.1             | 25.2                         | 29.3                         | 32.8                         |

**Table S4.** Aerobic oxidation of secondary benzylic amines by TiO<sub>2</sub> and 0.5 mol% Au/TiO<sub>2</sub> at 25 °C, 12h visible-light irradiation.

| Catalyst                     | Substrate                                                                           | Conversion (%) | Product selectivity (%)                                                                                                                                                                                                                                                                                                                                            |
|------------------------------|-------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TiO <sub>2</sub>             |  | 42.4           | <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <br/>3 </div> <div style="text-align: center;"> <br/>97 </div> </div> |
| 0.5 mol% Au/TiO <sub>2</sub> |  | 23.6           | <div style="text-align: center;"> <br/>100 </div>                                                                                                                                                                                                                             |