

## Supporting Information

### Ultrasensitive detection of Trinitrotoluene by $\text{Fe}_3\text{O}_4@\text{mTiO}_2/\text{P-ATP-TNT}/\text{Au}@Ag$ SERS sensor via synergetic effect

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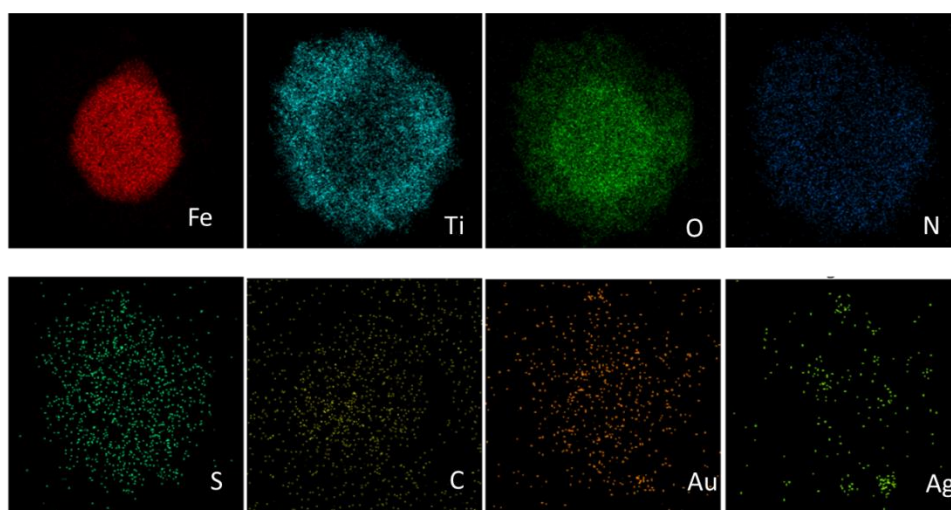
### Materials

Ferric (III) chloride hexahydrate ( $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ ), tetrachloroauric acid tetrahydrate ( $\text{HAuCl}_4 \cdot 4\text{H}_2\text{O}$ ), silver nitrate ( $\text{AgNO}_3$ ), trisodium citrate dihydrate ( $\text{C}_6\text{H}_5\text{Na}_3\text{O}_7$ ), polyethylene glycol (PEG), sodium acetate anhydrous (NaAc) and ethylene glycoethanol (EG) were obtained from Shanghai Chemical Reagents Company (Shanghai, China). P-aminothiophenol (P-ATP) was purchased from Aladdin. 2,4,6-Trinitrotoluene (TNT) was supplied by National Security Department of China. The deionized (DI) water with a electrical resistivity of 18.25  $\text{M}\Omega\cdot\text{cm}$  was purified using a Millipore Milli-Q gradient system.

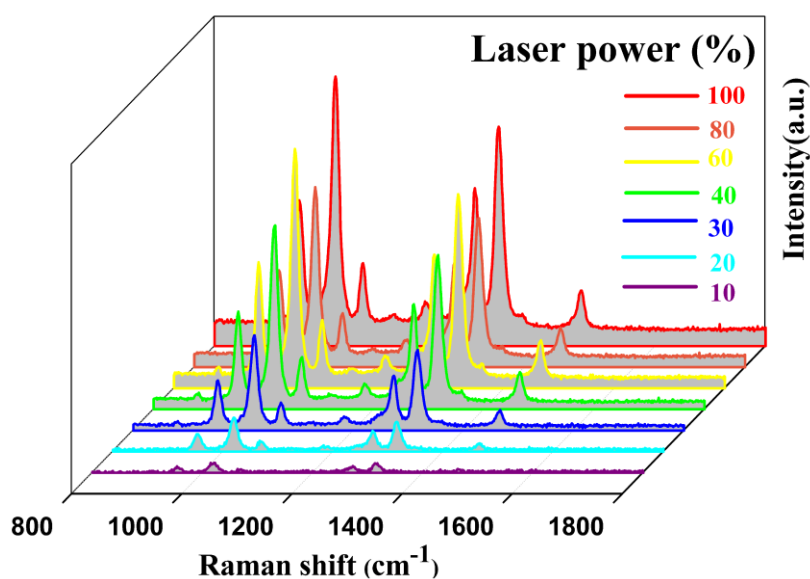
### Instrumentation and Characterization

The characterization of the products were analyzed by using a Quanta 200 FEG field

emission scanning electronic microscope (FESEM), a JEOL JEM-2010 high-resolution transmission electron microscope (HRTEM), a Philips X-Pert Pro X-ray diffractometer (XRD) with Cu K $\alpha$  radiation ( $\lambda = 1.5418 \text{ \AA}$ ), The SERS substrates of the P-ATP by using a portable-Raman spectrometer (B&W TEK, i-Raman) equipped with a diode laser emitting at 785 nm, the laser power was 30 mW and the integration time was 5 s.



**Fig. S1** elemental distribution mappings of Fe<sub>3</sub>O<sub>4</sub>@mTiO<sub>2</sub>/P-ATP/Au@Ag NPs



**Fig. S2** SERS spectra of P-ATP at various laser powers in Fe<sub>3</sub>O<sub>4</sub>@mTiO<sub>2</sub>/P-ATP/Au@Ag assemblies

**Table S1.** Wavenumbers and assignments of Raman band of P-ATP and DMAB.

P-ATP		DMAB	
wavenumber (cm <sup>-1</sup> )	assignment	wavenumber (cm <sup>-1</sup> )	assignment
<b>1078</b>	<b>v<sub>CS</sub></b>	<b>1078</b>	<b>v<sub>CS</sub></b>
<b>1181</b>	<b>v<sub>CH</sub></b>	<b>1141</b>	<b>β<sub>CH</sub> + v<sub>CN</sub></b>
<b>1595</b>	<b>v<sub>CC</sub></b>	<b>1181</b>	<b>v<sub>CH</sub></b>
		<b>1388</b>	<b>v<sub>NN</sub> + v<sub>CN</sub></b>
		<b>1429</b>	<b>v<sub>NN</sub> + β<sub>CH</sub></b>
		<b>1595</b>	<b>v<sub>CC</sub></b>

Abbreviations: v, stretching; β, in-plane bending.