Supplementary Information

1. Materials

Oxalic acid (>99.5%), malonic acid (99.5%), succinic acid (99%), silver nitrate (> 99.95), sodium citrate (99%), anhydrous ethanol and hydrochloric acid (36%) can be used without further purification, they purchased from Sinopharm Group Chemical Reagent Shenyang C. PNTP purchased from Aladdin.

2. Preparation of silver nanoparticles

The synthesis of nano silver particles is carried out by Lee and Meisel method: 18 mg of $AgNO_3$ dissolved in deionized water, diluted to 100 mL, transferred to the reaction in the bottle, heated to boiling, temperature stability, in the condition of stirring quickly add 2 mL of 1% sodium citrate solution, reaction liquid from colorless to yellow and then to sage green transparent sol, stop the heating and cooling to room temperature.[1]

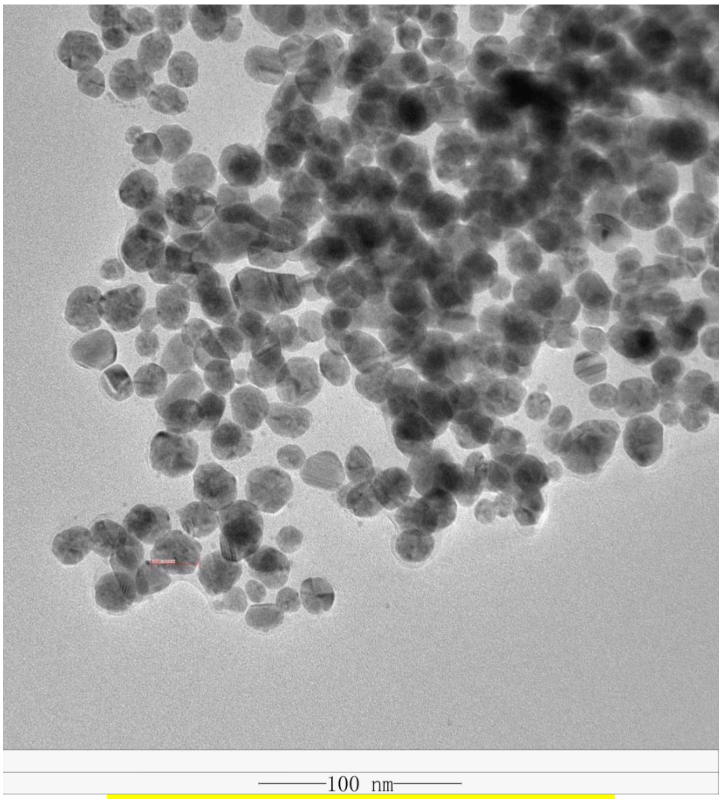

Fig. S1 TEM imaging of silver nanoparticles.

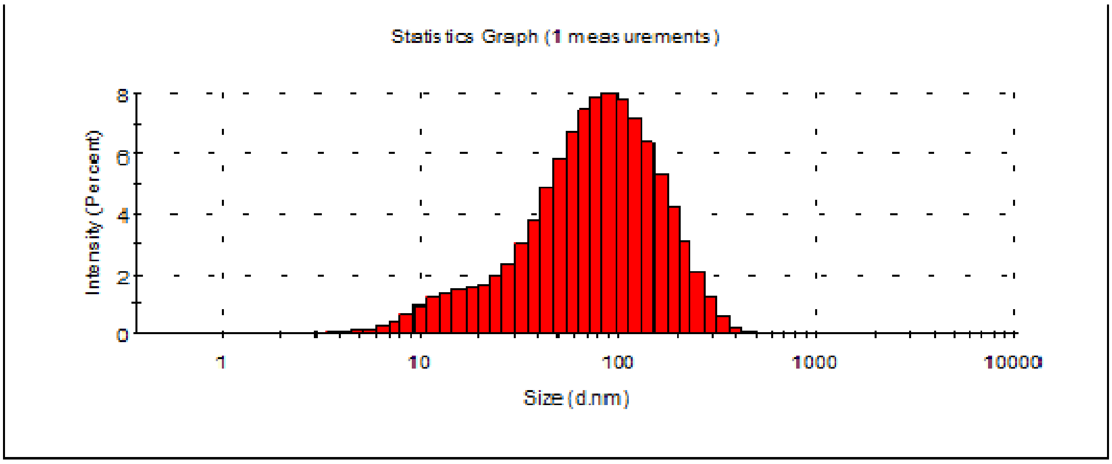

Fig. S2 The size distribution of silver nanoparticles.

3. Experimental methods

The acidity using ray magnetic pHS-3C pH meter which can adjust pH. The PNTP using ethanol as solvent with the 1 × 10^{-4} M add different acid respectively mixed with 1:1 volume of silver sol after about 5 h, Raman spectroscopy test.

The Raman spectra of PNTP on AgNPs were measured with Renishaw inVia Raman system equipped with an integral microscope (Leica). Lasers with wavelength of 633 and 532 nm were used as the excitation sources. In our Raman experiment, the laser power irradiating the SERS sample was measured at ≤ 10 mW and ≤ 17mW with a 50 objective. The appropriate holographic notch filter was placed in the spectrometer, and the holographic grating (1800 grooves/mm) and slit installed in the spectrometer produced a spectral resolution of 1 $cm^{-1}$with a repeatability of ≤ 50 μm Raman scattering was detected using a Peltier-cooled CCD detector (576 pixels×384 pixels). The data acquisition time used in the experiment was 10 s for one spectrum.

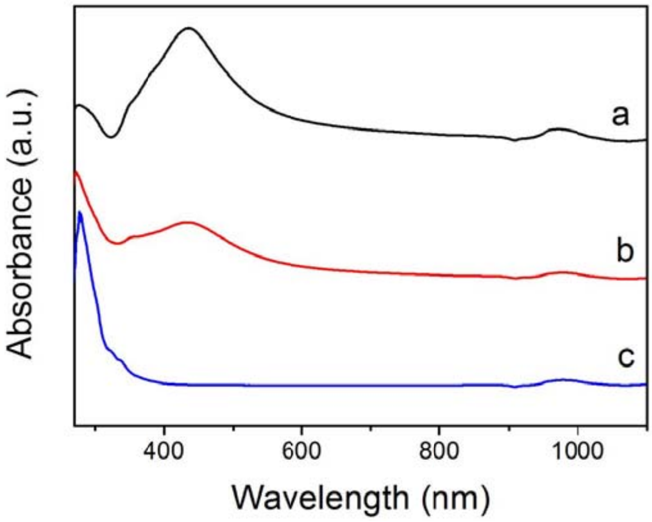

Fig.S3 (a) UV-vis spectra of Ag NPs. (b) UV-vis spectra of PNTP on Ag NPs with HCl. (c) UV-vis spectra of PNTP on Ag NPs with organic acids.

As shown in Fig. S3a, λ_{max} value for Ag NPs is 435 nm. Fig. S3b shows the UV-vis spectra of PNTP on Ag NPs with HCl, that λ_{max} values are 435 nm and 280 nm. Fig. S3c shows the UV-vis spectra of PNTP on Ag NPs with organic acids, that λ_{max} values are 435 nm and 280 nm.

The absorption peak at 280 nm and the absorption peak at 435 nm are weakened by comparing Fig. S3a andFig.S3b, which indicates that the formation of new material on the surface of Ag NPs due to PNTP adsorption leads to the reduction of the amount of AgNPs. By comparing Fig. S3b and S3c, the absorption peak at 435 nm in Fig. S3c disappears and the absorption peak at 280 nm is remarkably enhanced. In general, the interaction between PNTP and AgNPs was significantly larger than that of the system with HCl addition by comparing the absorption peak at 435 nm and 280 nm. This further suggests that the addition of organic acids at the same pH increases the rate of DMAB formation relative to the HCl added system PNTP.

Notes and references

1. X. Yan, L. Wang, X. Tan, B. Tian and J. Zhang, *Sci.Rep.*, 2016, **6**, 30193.