

Electronic Supplementary Material (ESI) for *RSC Advances*

## **Sodium alginate-assisted photosynthesis of complex silver microarchitectures**

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### **Experimental section**

#### **1. Materials**

Sodium alginate was purchased from Sigma (viscosity of 2 % solution at 25 °C, 250 cps). The residual of chloride in commercial sodium alginate noted above were analyzed by an ion chromatography (Dionex Company, DX600, USA). Silver nitrate was spectrum pure and obtained from commercial sources. Crystal violet (CV) from Sigma-Aldrich was used as Raman probe. All other chemical reagents in the study were analytical grade and obtained from commercial sources. Ultrapure water used in all experiments was produced by Milli-Q synthesis system (Millipore Corp. USA).

#### **2. Photosynthesis of complex microarchitectures and independent particles**

##### **2.1 Synthesis of flower-like, complex Ag microarchitectures**

Typically, the commercial sodium alginate powder was dissolved in ultrapure water to obtain a 0.5 % (w / v) solution. A 0.1 % (w / w) aqueous solution of AgNO<sub>3</sub> was added dropwise into an equal volume of sodium alginate solution. After complete

mixing, the mixture was irradiated in the air at room temperature by natural light (400-700 lux horizontal illuminance) for 1h. To obtain the intermediate state of complex Ag architectures, the mixture of AgNO<sub>3</sub> and sodium alginate was irradiated for 30 min.

## **2.2 Synthesis of Ag nanoparticles**

Sodium alginate was purified by dialysis for Cl ions removal. As a control, purified sodium alginate of 0.5 % (w / v) was mixed with 0.1 % (w / w) aqueous solution of AgNO<sub>3</sub>, the mixture was irradiated in the air at room temperature by natural light (400-700 lux horizontal illuminance) for 8h.

Alternatively, commercially available natural polysaccharides including chitosan (Mw. 300000, 0.5 % w / v), carboxymethylcellulose (Mw. 250000, 0.5 % w / v), soluble starch (3.3 cps of viscosity of 2 % solution, 0.5 % w / v) were employed to replace SA in the system, while AgNO<sub>3</sub> concentration was 0.1 % and natural light irradiation was set 1h.

## **3. Characterizations**

### **3.1 Transmission electron microscopy (TEM)**

For TEM (Tecnai G2 F20, FEI Company, USA) and high-resolution TEM (HRTEM, Tecnai G2 F20, FEI Company, USA), a drop of diluted aqueous suspension of various samples was deposited on the carbon-coated 200 mesh copper grid and air dried prior to observation.

### **3.2 Scanning electron microscopy (SEM)**

The samples were air-dried on the micrograte and observed by field emission SEM (FESEM, Nanosem 430FEI Company, with 10 kV operating voltage).

### **3.3 X-ray diffraction analysis (XRD)**

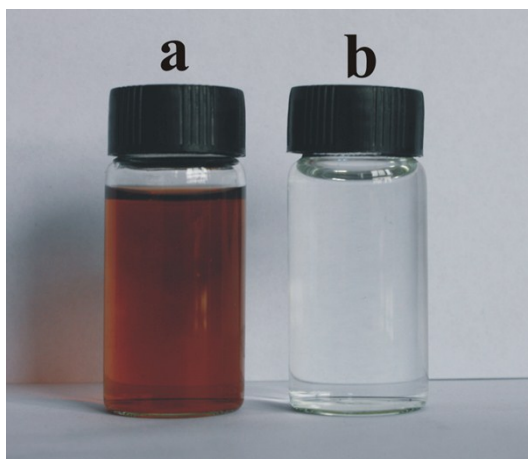
The XRD measurement of these samples was carried out using a powder diffractometer (Rigaku MultiFlex) with Cu K $\alpha$  as an X-ray source. The scattering angle ( $2\theta$ ) was in the range of 20 - 80°.

### 3.4 UV-vis absorption spectroscopy

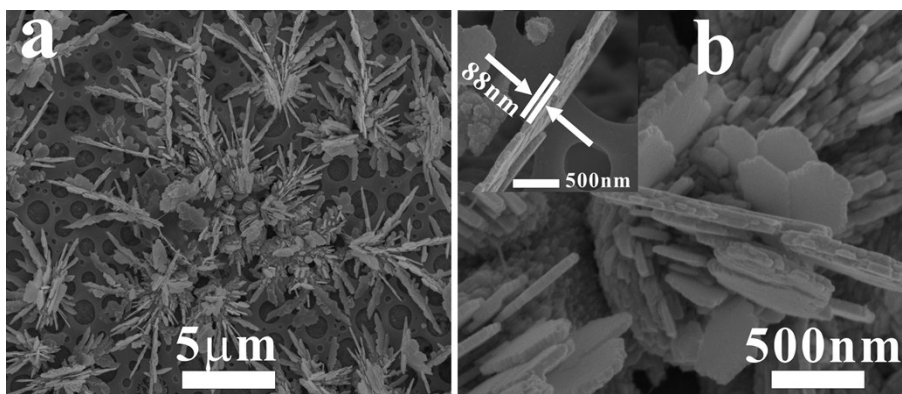
The solutions of flower-like, complex Ag microarchitectures, particles separated from flower-like Ag architectures and Ag spherical particles were recorded on a UV-vis spectrophotometer (Perkinelmer Lambda 35).

### 3.5 Raman Spectroscopy

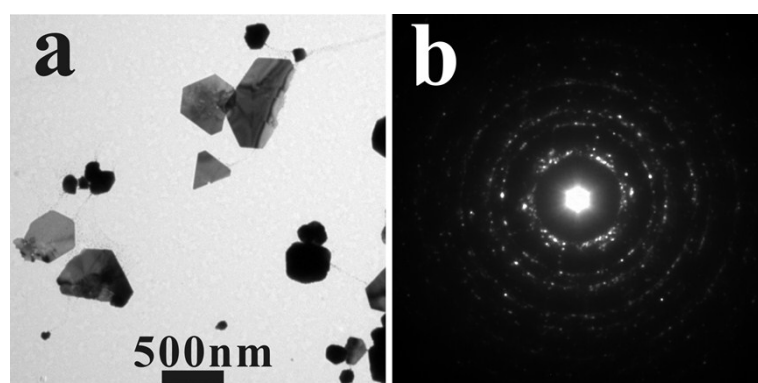
A drop of  $2 \times 10^{-6}$  M of crystal violet aqueous solution was placed on the substrate of quartz slip, Ag spherical particles and flower-like, complex Ag microarchitectures, respectively. SERS spectra were recorded using 633 nm excitation with acquisition time of 3s and accumulation for 3 times (DXR Microscope, Thermo).



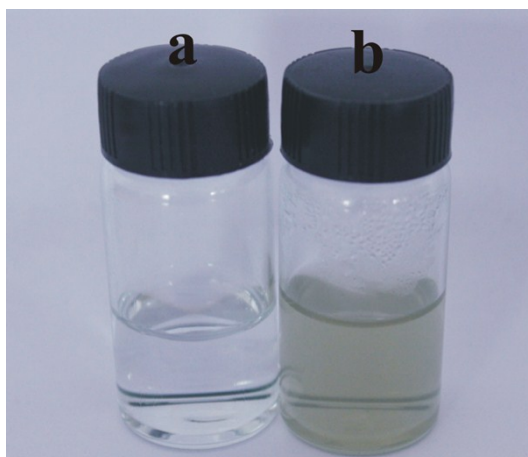
**Fig. S1** The digital picture of the mixed solution of AgNO<sub>3</sub> (0.1 %) and commercially available sodium alginate (0.5 %). (a), natural light irradiation for 1h; (b), before natural light irradiation.



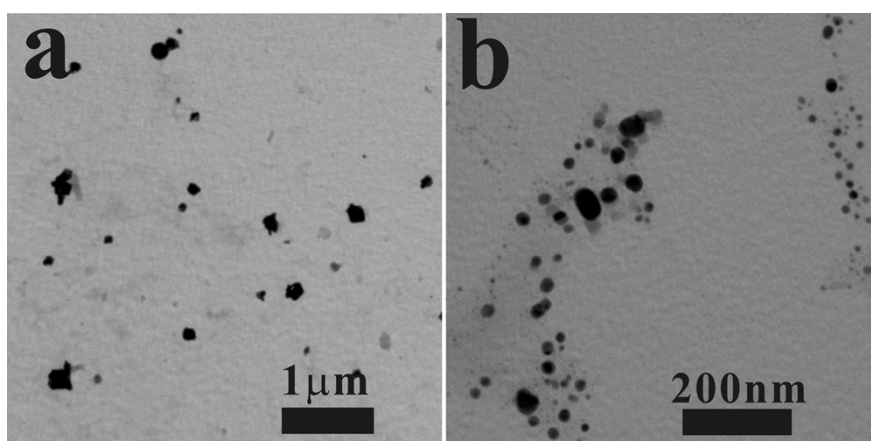
**Fig. S2** low- (a) and high- (b) magnification SEM images of flower-like Ag microarchitectures, which show nanoplates were adhered to each other and erected on the substrate. The mixed solution of AgNO<sub>3</sub> (0.1 %) and commercially available sodium alginate (0.5 %) was irradiated by natural light for 1 h.



**Fig. S3** TEM image of Ag nanoplates obtained by centrifugation of as-synthesized flower-like microarchitectures (a) and selected area electron diffraction pattern (b) of flower-like microarchitectures.



**Fig. S4** The digital picture of the mixed solution of  $\text{AgNO}_3$  (0.1 %) and purified sodium alginate (0.5 %). (a), before natural light irradiation; (b), natural light irradiation for 8h.



**Fig. S5** TEM images of carboxymethylcellulose (a) and soluble starch (b) assisted photosynthesized Ag nanoparticles.  $\text{AgNO}_3$ : 0.1 %; Carboxymethylcellulose: 0.5 %; Soluble starch: 0.5 %. Irradiation time: 1h.