Supplementary Material (ESI) for Chemical Communications

Supporting Information for

Highly ordered rectangular silver nanowire monolayers: water-assisted synthesis and galvanic replacement reaction with $HAuCl_4$

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Experimental Section

1 Synthesis of rectangular silver nanowires

The silver nanowires were prepared by a modified polyol process. In a typical synthesis, 1, 2-Propylene glycol (1, 2 PG, 10mL) that contained poly (vinyl pyrrolidone) (PVP, M_W≈50000, 150 mM as calculated in terms of the repeating unit) was placed in a 25-mL vial, capped, and heated with stirring in an oil bath at 160 °C for 1 h. 1 mL NaCl solution (1 mM in 1, 2 PG) was then quickly added. After 5 min, $AgNO_3$ (0.15 M solution in 1, 2 PG, 4 mL) were added with drop by drop to the stirring solution. The vial was then capped and heated at 160 °C for 40 min. After injection of the $AgNO_3$ solution, the color of reaction mixture changed from milkiness to light yellow, and silvery white. After synthesis, the wire solution was cooled to room temperature.

2 Synthesis of rectangular silver nanowire monolayers

The above samples were diluted in a 1:10 ratio with water and stirred strongly for 20 min. After that, the dilute nanowire solution kept stillness for 3 hours, then the silver nanowires deposited on the bottom of vessel and upside solution containing ployols, silver nanoparticles, and excess PVP has been removed. This process was repeated for four times. With this simple process, it can be clearly seen that the silver nanowire layers have been formed on the surface of water. This film can be easily transferred onto a wide range of substrates including Si, glass, plastic, and paper for practical applications. Furthermore, in order to investigate the relationship between the structures of Ag nanowires and water washing process, the times of water washing process were increased up to 7, 10, and 15, respectively. Furthermore, the residual PVP amounts after various water washing processes have been quantified through the dilution-ratio calculation method and shown

in below table.

Water washing Times	**0**	**4**	**7**	**10**	**15**
Residual PVP amount	150 mM	0.113 mM	8.5×10^{-5} mM	6.4×10^{-8} mM	3.9×10^{-13} mM

3 Synthesis of gold nanoneedle arrays

In a typical synthesis of gold nanoneedle arrays, aqueous $HAuCl_4$ (0.02M) was slowly added dropwise to the silver naniwire arrays supported on the substrates (glass wafer). The resulting product was maintained at the room temperature for 30 minutes. The obtained samples for morphology and structure analysis were washed with water.

4 Characterizations

The transmission electron microscopy (TEM) images were obtained on a transmission electron microscope (JEM1200-EX, JEOL) with an accelerating voltage of 80 kV. A drop of the solution containing samples was put onto a carbon-supported copper mesh, which was dried at room temperature. SEM images were taken using a scanning electron microscope (JSM-5600LV, JEOL) operated at an accelerating voltage of 10–20 kV. FE-SEM images were taken using a field-emission scanning electron microscope (JSM-6701F, JEOL) operated at an accelerating voltage of 5 kV. An energy-dispersive (ED) detector was equipped with this field-emission scanning electron microscope and operated at an accelerating voltage of 20 kV. The X-ray diffraction spectra (XRD) measurements were performed on a Philips X' pert MPD instrument using Cu Kα radiation (50 kv). The XRD patterns were recorded from 10° to 90°with a scanning rate of 0.067°/ s. UV/Vis absorption spectra were taken at room temperature on a Hewlett Packard 8453 spectrometer.

Additional Figures

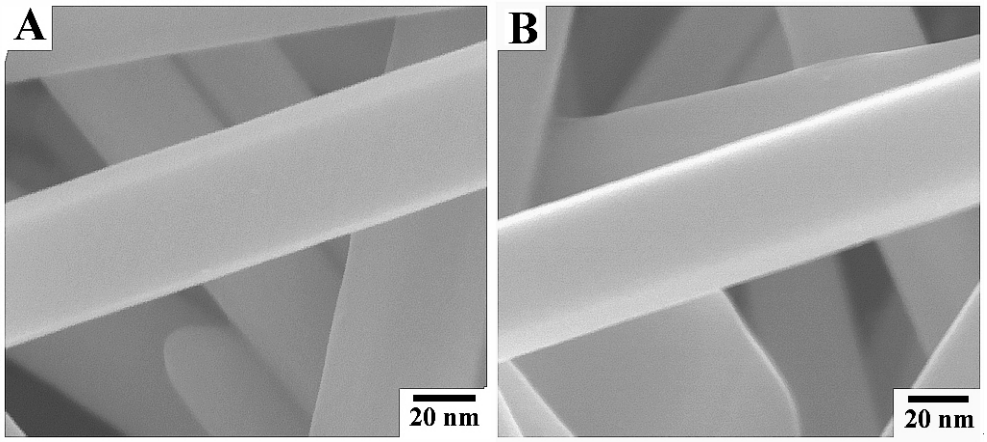

Fig. S1. (A-B) SEM images of the rectangular silver nanowires before water washing process.

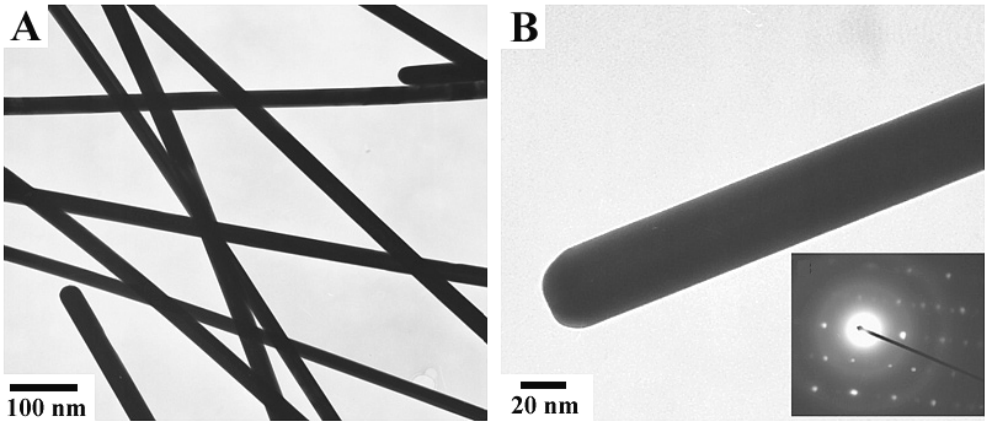

Fig. S2 (A) TEM image of the rectangular silver nanowires. (B) TEM image and SAED pattern of single rectangular silver nanowire.

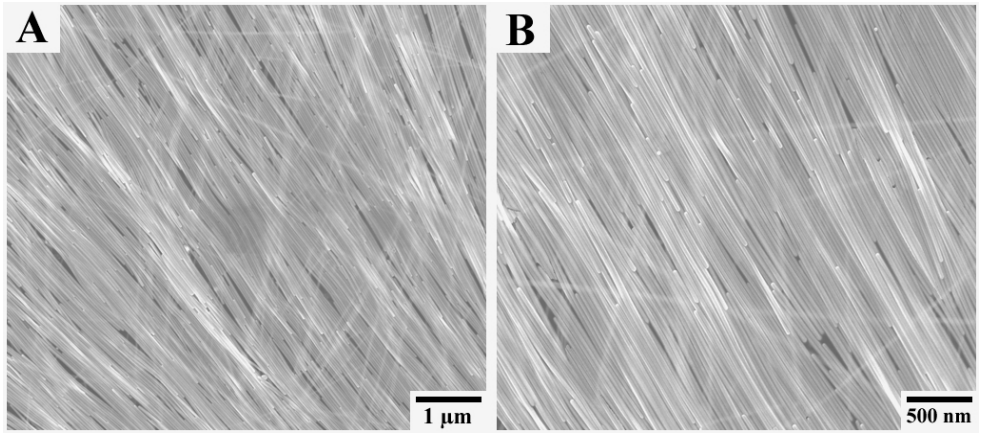

Fig. S3. (A-B) LR-SEM images of silver nanowire monolayers.

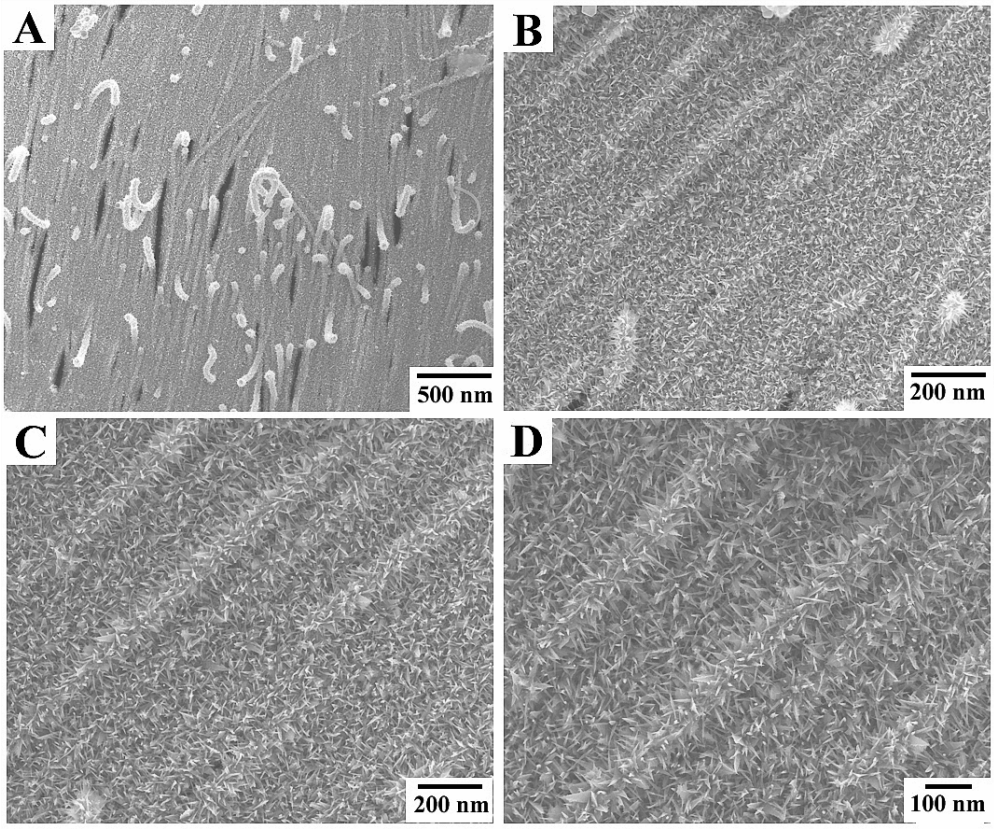

Fig. S4. (A-D) SEM images of the gold nanoneedle arrays.

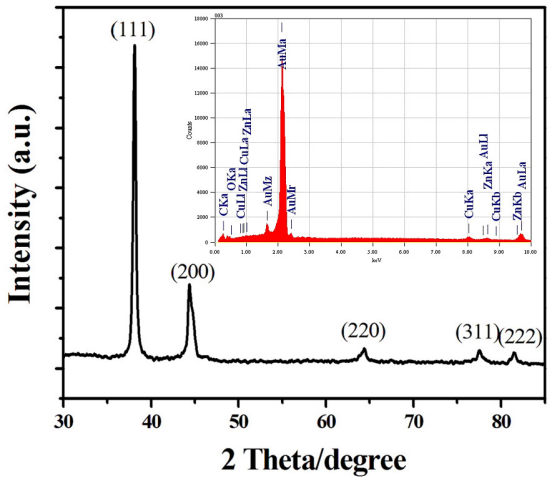

Fig. S5. XRD and EDS patterns of the gold nanoneedle arrays.

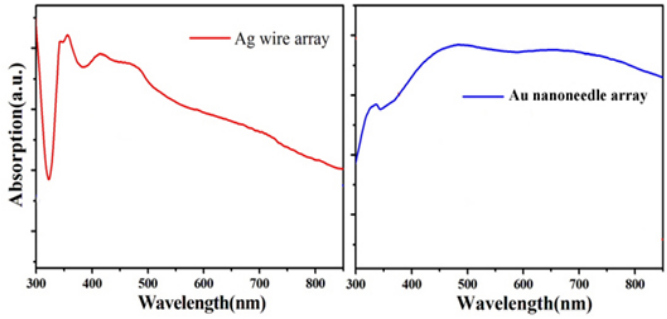

Fig. S6.The surface plasmon resonances of Ag nanowire monolayers and Au nanoneedle arrays

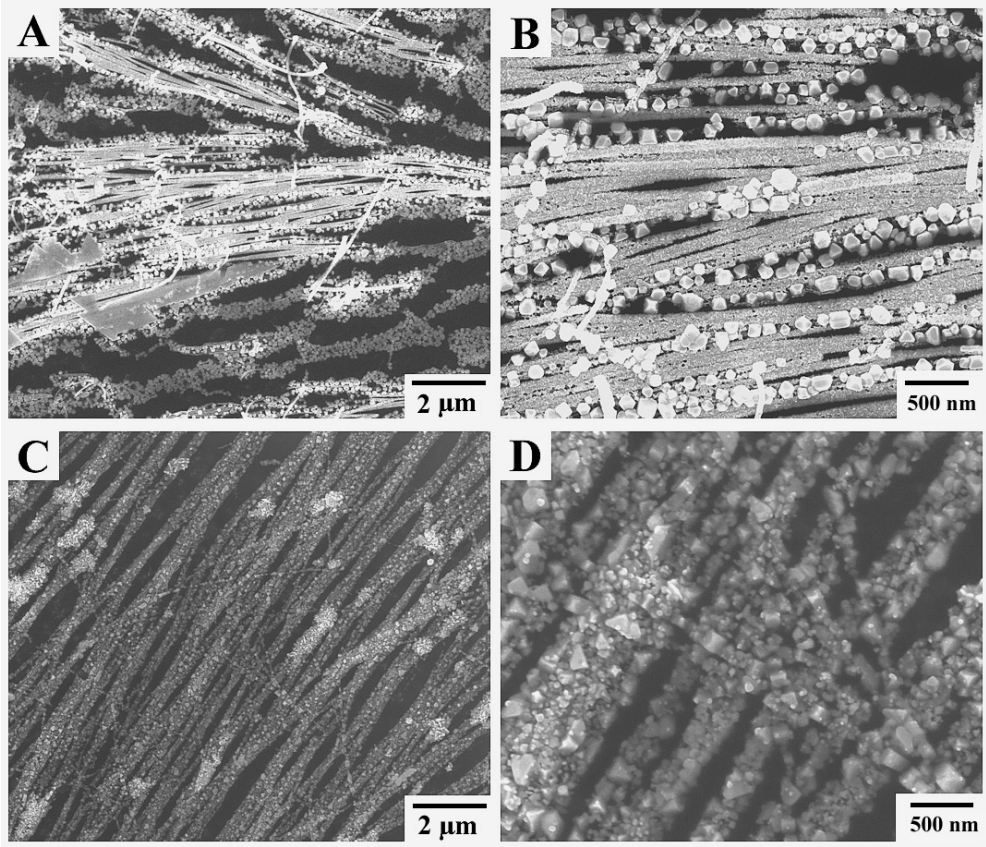

Fig. S7. (A,B) SEM images of the gold nanostructures produced from the silver nanowires arrays shown in Fig. 3A. (C,D) SEM images of the gold nanostructures produced from the silver nanowires arrays shown in Fig. 3B.

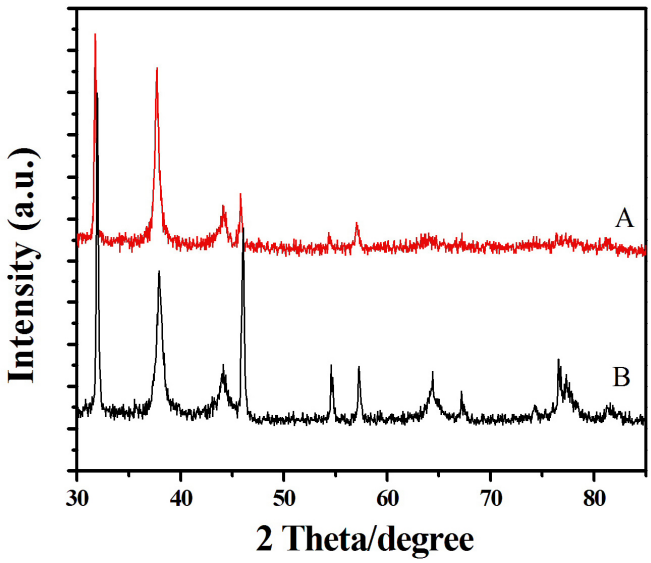

Fig. S8. XRD patterns of nanoproducts: (A) for Fig. S6A and S6B; (B) for Fig. S6C and S6D