Supplementary Material (ESI) for Chemical Communications

Supporting Information for

Heteroepitaxial growth of platinum nanocrystals on AgCl nanotubes via galvanic replacement reaction

Yingpu Bi and Jinhua Ye *

International Center for Materials Nanoarchitectonics (MANA), and Photocatalytic Materials Center, National Institute for Materials Science (NIMS), 1-2-1 Sengen, Tsukuba, Ibaraki 305-0047, Japan

*To whom correspondence should be addressed.

Email: jinhua.ye@nims.go.jp

Experimental Section

1 Synthesis of Ag nanowires

The Ag nanowires were prepared by a modified polyol process. In a typical synthesis, 1,3-butylene glycol (1, 3 BG, 10mL) that contained poly (vinyl pyrrolidone) (PVP, $M_W \approx 50000$, 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 Na_2S solution (1 mM in 1, 3 BG) was then quickly added. After 5 min, $AgNO_3$ (0.15 M solution in 1, 3 BG) were added with drop by drop to the stirring solution. The vial was then capped and heated at 160 °C for 30 min. After injection of the $AgNO_3$ solution, the color of reaction mixture changed from dark to blue, then to light yellow, and ocher color. The samples for morphology and structure analysis were washed with acetone and water to remove excess ployols and PVP via centrifugation, finally was dissolved in water.

2 Synthesis of Ag/AgCl core-shell nanowires

In a typical Ag/AgCl core-shell nanowires synthesis, the reaction mixture containing the as-synthesized Ag nanowires (10 mg) solution was added to aqueous solution (PVP 50 mM). Aqueous $FeCl_3$ (0.02M) was slowly added dropwise to this Ag nanowire solution. The resulting mixture was maintained at room temperature until its color became brown. Vigorous stirring was employed throughout the synthesis. The obtained samples for morphology and structure analysis were washed with water and ethanol to remove the $FeCl_3$ and PVP via centrifugation. Finally, the obtained Ag/AgCl samples were dissolved in water.

3 Synthesis of Pt/AgCl hetero-nanotubes

The Pt/AgCl hetero-nanotubes were synthesized by mixing the as-synthesized Ag/AgCl core-shell nanowires (Ag/AgCl: 28/72) and H_2PtCl_6 solution. The resulting mixture was maintained at room temperature until its color became black. Vigorous stirring was employed throughout the synthesis. The obtained samples for morphology and structure analysis were washed with water and ethanol via centrifugation. HNO_3 solution treatment was performed in order to remove the trace silver.

4 Electrochemical activities

Electrochemical activities of Pt/AgCl hetero-nanostructures were measured by cyclic voltammetry method using a standard three-electrode cell at the computer-controlled CHI650A electrochemical workstation. Two milligram of catalysts was suspended in 2 mL distilled water, the mixtures were ultrasonically scattered for 15 min to form homogeneous solution. Then, 5 μL solution was dropped on the glassy carbon (GC) electrode (3 mm diameter, 0.0706 cm^2). After evaporation of the water in air, 5 μL of a 1 wt% nafion solution (diluted from 5 wt% nafion with water) was transferred onto the electrode surface to attach the catalyst particles to the GC electrode. A Pt wire and saturated calomel electrode (SCE) were used as the counter and reference electrode, respectively. Methanol oxidation experiment was measured in a solution of 1M KOH + 1M CH_3OH at room temperature. For all experiments the sweep rate was $50mVs^{-1}$.

5 Characterizations

SEM and FE-SEM images were taken using a field-emission scanning electron microscope (JSM-6701F, JEOL) operated at an accelerating voltage of 5 kV, which equipped with an X-ray Energy-Dispersive Spectroscopy (EDS) system. 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 UV-2550 (Shimadzu) spectrometer.

Additional Figures

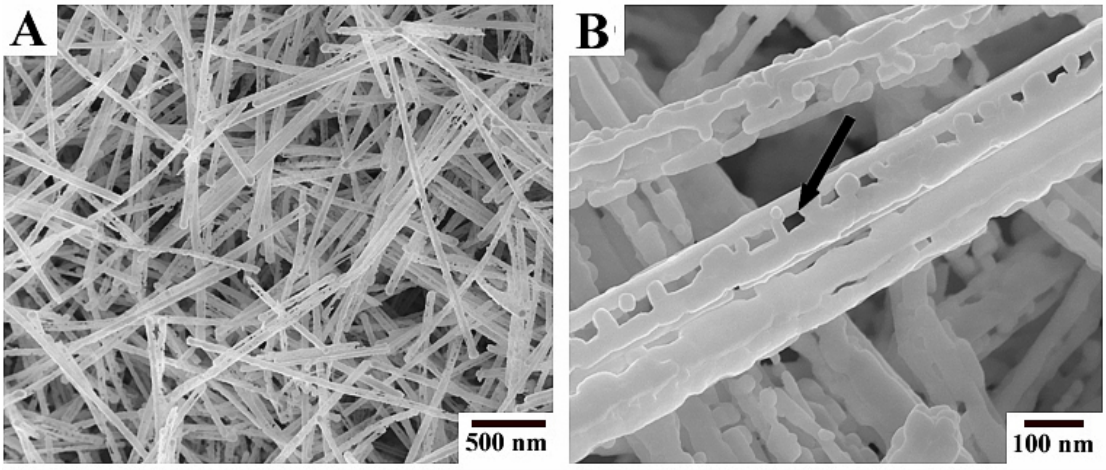

Fig. S1. (A, B) SEM images of AgCl hollow nanostructures.

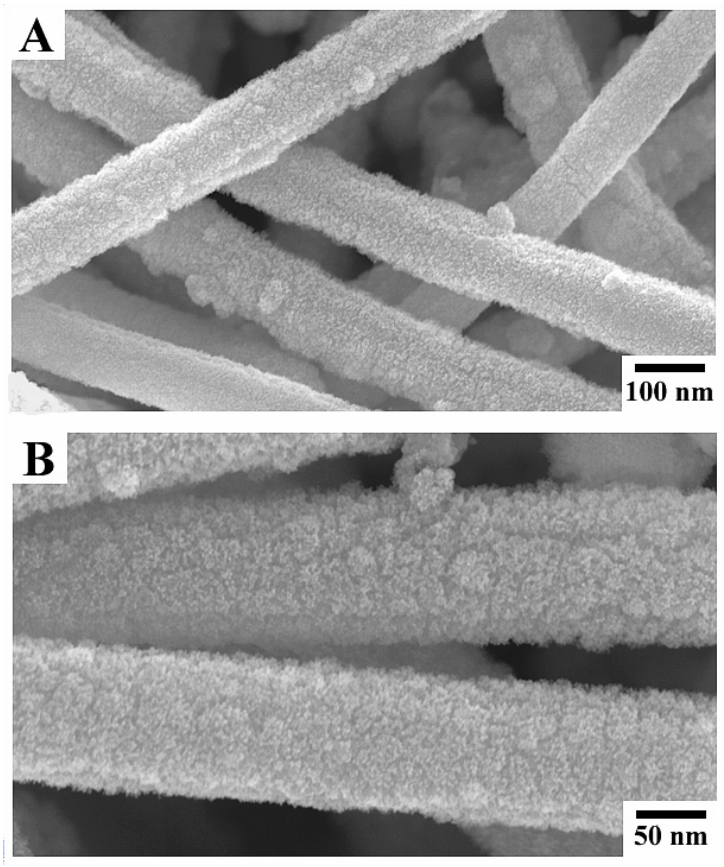

Fig. S2. (A,B) SEM images of Pt/AgCl hetero-nanotubes with different magnifications.

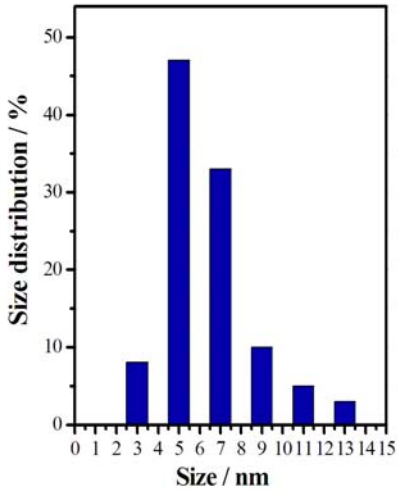

Fig. S3. Size-distribution of platinum nanocrystals.

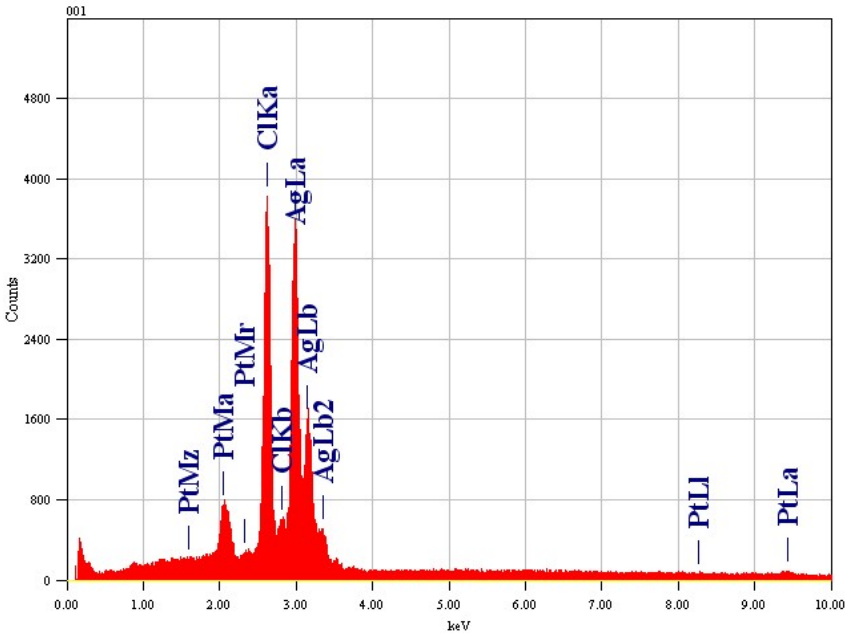

Fig. S4. EDS pattern of Pt/AgCl hetero-nanotubes.