

Direct Growth of Novel Alloyed PtAu Nano-dendrites

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Supporting Information

Characterization of the PtAu nanodendrites

The surface morphology of the synthesized samples was characterized using scanning electron microscopy (SEM) (JEOL JSM 5900LV) and transmission electron microscopy (TEM) (JEOL 2010F). Surface composition was investigated by an energy dispersive X-ray spectrometer (EDS) (Oxford Links ISIS) and X-ray photoelectron spectroscopy (XPS) (Omicron EA-125 energy analyzer and a multi-channel detector) with a monochromatic Mg K α X-ray source ($h\nu = 1253.6$ eV). Surface compositions based on quantitative EDS analysis are reported in average values of readings taken at five different spots on each sample surface. The X-ray diffraction (XRD) patterns of the as-prepared samples were recorded using a Philips PW 1050-3710 Diffractometer with Cu K α radiation. XRD patterns were compared and assigned according to the database of the International Centre for Diffraction Data (ICDD). All binding energies (BE) reported were corrected using the C 1s peak at 284.5 eV as an internal standard. Atomic sensitivity factors were employed for calculating the surface metallic compositions from the integrated peak areas. Cyclic voltammetry (CV) and chronoamperometry (CA) were carried out using the three-electrode cell system. In all cases a platinum coil was used as the counter electrode and was flame annealed before each experiment. The working electrode was the Ti-supported PtAu catalyst. For comparison, the nanoparticle Pt electrode fabricated under the same hydrothermal condition as that for the nanodendrite PtAu electrode was also used as the working electrode. A saturated calomel electrode (SCE) was used as the reference and connected to the investigated electrolyte through a salt bridge. All potentials reported in this communication refer to the SCE reference electrode. Data acquisition and analysis were performed with a Solartron 1287 Potentiostat using the software CorrWare. The electroactive surface area of the nanodendrite PtAu electrode and nanoparticle Pt electrode is found to be 105 cm² and 58 cm², respectively. They were determined by calculating the charge associated with hydrogen adsorption/desorption peak in sulfuric acid¹ and were used to calculate the current densities. All solutions were deaerated with ultra-pure argon (99.999%) before measurements and argon was passed over the top of the solution during the experiments. All measurements were conducted at room temperature (22 \pm 2 $^{\circ}$ C).

[1] X. Peng, K. Koczkur, S. Nigro and A. Chen, *Chem. Commun.*, 2004, 2872.

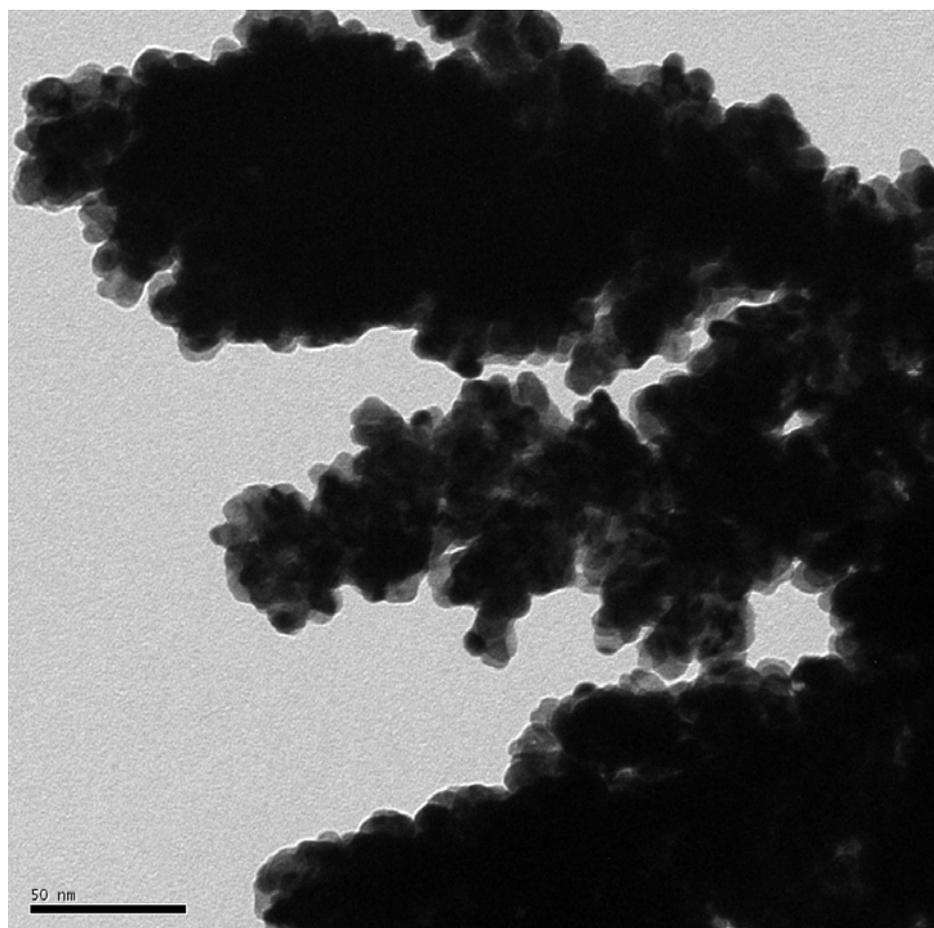


Figure S1. TEM image of the ramified branches from the as-synthesized PtAu nanodendrites.

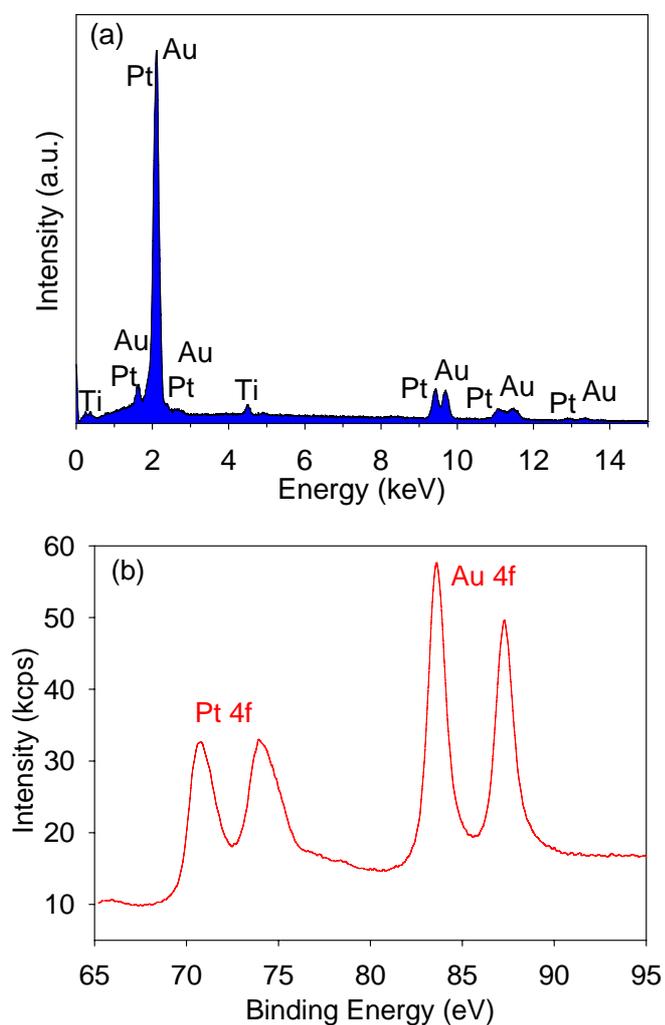


Figure S2. Energy dispersive X-ray spectrum (EDS) (a) and Pt 4f and Au 4f X-ray photoelectron spectra (XPS) (b) for the as-synthesized PtAu nanodendrites.

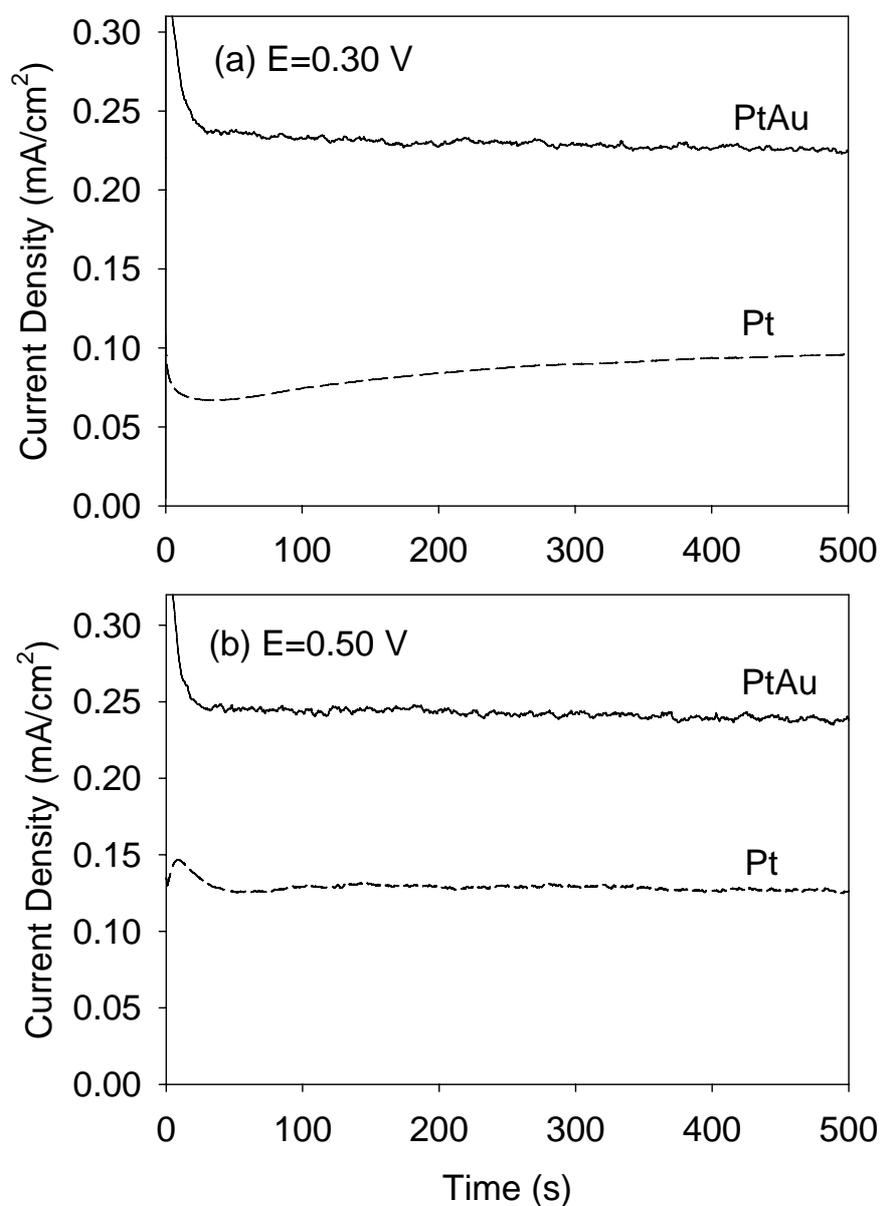


Figure S3. Chronoamperometric curves of the nanodendrite PtAu (solid line) and nanoparticle Pt (dashed line) electrodes in a solution of 0.1 M formic acid + 0.1 M sulfuric acid. The electrode potentials were first held at -0.10 V for 60 s, then stepped up to +0.30 V (a) and +0.50 V (b) for 500 s. The current densities were calculated per active surface area of each electrode.

Table S1. Steady-state current densities (mA/cm^2) at the three applied potentials for the nanodendrite PtAu and nanoparticle Pt electrodes measured in a solution of 0.1 M formic acid + 0.1 M sulfuric acid.

	0.15 V vs SCE	0.30 V vs SCE	0.50 V vs SCE
PtAu	0.183	0.225	0.239
Pt	0.040	0.096	0.126