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Unusual Corrosion Process of Gold Nanoplates and the Mechanism Study

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1. Experimental Details

The gold nanoplate samples used to investigate the localized corrosion were separated from the growth solutions by centrifugation at 15000 r/min. After being washed with ultra-pure water three times, they were transferred to a 5 mM SDBS solution or to a mixed solution of 5 mM SDBS and 0.5 mM $HAuCl_4$. The obtained mixtures were placed in an ultrasonic bath for 10 min with strong ultrasonic vibration, to enhance the etching rate of gold nanoplates.

All electrochemical measurements were carried out in a conventional three-electrode cell at ambient temperature by using a CHI 760C electrochemical workstation. A glassy carbon electrode embedded in the Teflon mould was used as the working electrode, a 1.0 cm × 2.0 cm Pt plate and a saturated calomel electrode (SCE) were used as the counter electrode and the reference one, respectively. The electrolytic solutions were deaerated by N_2 bubbling for 10 min prior to each measurement and a blanket of N_2 was maintained throughout the whole experiment. Cyclic voltammograms (CVs) for the glassy carbon electrode in 0.1 M KNO_3 + 0.5 mM $HAuCl_4$ mixed solutions with and without SDBS were acquired through linear potential scan from the open-circuit potential (E_{ocp}) to the given negative vertex potential (0 V vs. SCE), then to the designated positive vertex potential (1.3 V vs. SCE), and finally backward to the initial potential at a scan rate of 50 mV s^{-1}.

The morphology of the gold nanoplates was characterized by a Hitachi H-800 transmission electron microscopy (TEM) and a JSM-6700F field emission scanning electron microscope (FESEM) operating at designated accelerating voltages. The samples were prepared by placing drops of the solution of gold nanoplates, which was centrifuged three times and redispersed in ultra-pure water, on Formvar-coated copper grids and silicon wafers, respectively. The UV-vis absorption spectra were measured with a Hitachi U-4100 UV-visible Spectrophotometer using a 1 cm path-length quartz cell.

2. TEM and SEM images and UV-visible Absorption Spectra

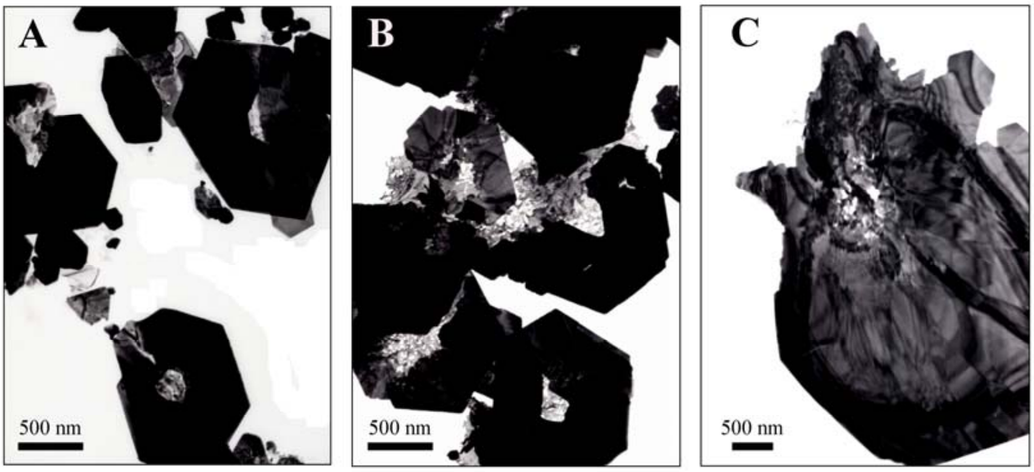

Fig.S1. A set of TEM images of the gold nanoplates synthesized in aqueous solutions of 20 vol% EG and 0.5 mM $HAuCl_4$ in the presence of 1 mM (A), 0.8 mM (B), and 0.5 mM (C) SDBS.

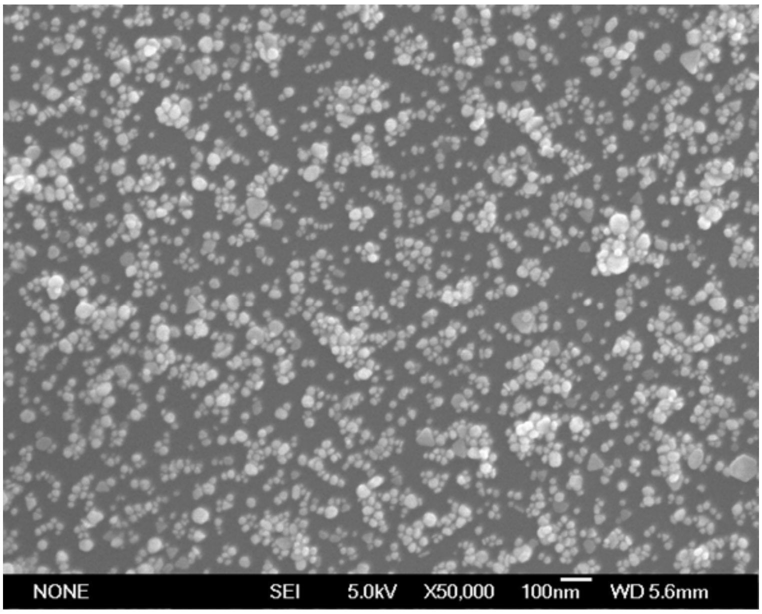

Fig.S2. The SEM image of the gold nanoparticles synthesized in the mixed aqueous solution of 5 mM SDBS, 0.5 mM $HAuCl_4$ and 20 vol% EG for 2 days at room temperature.

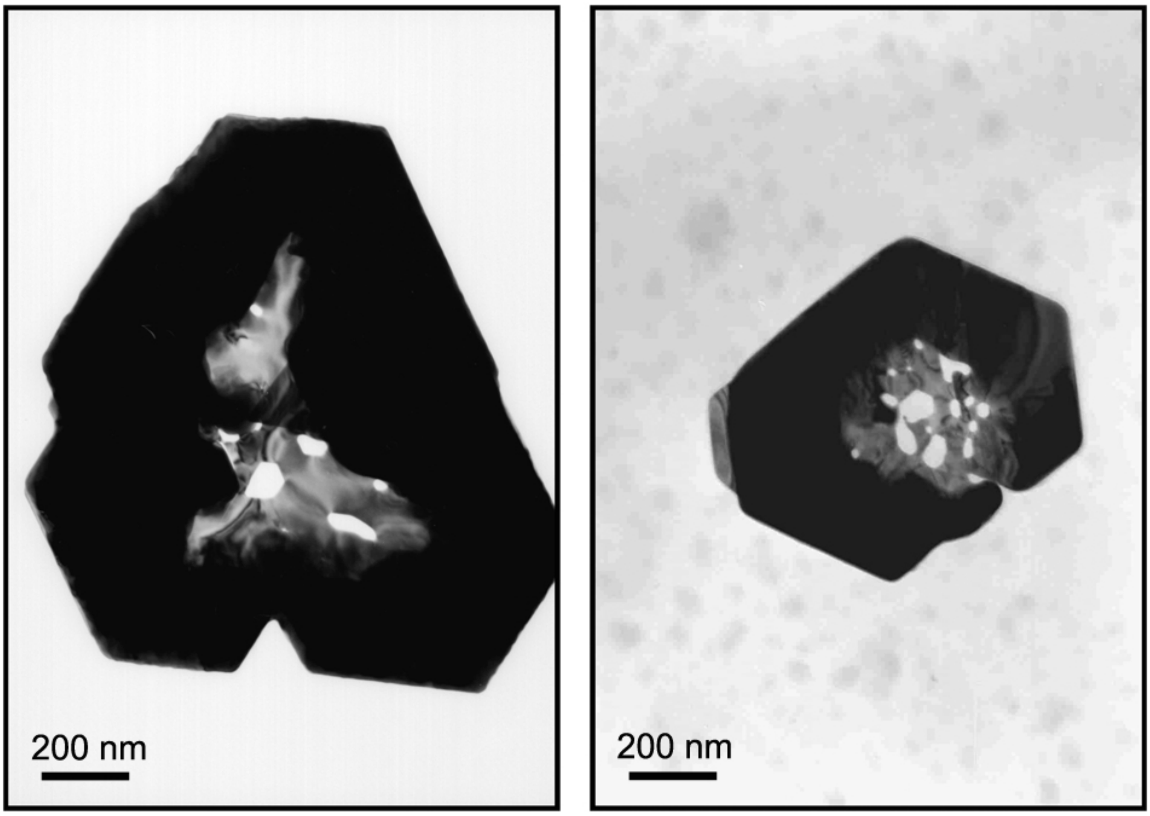

Fig.S3. TEM images of corroded gold nanoplates synthesized in aqueous solutions of 20 vol% EG, 0.5 mM $HAuCl_4$ and 1 mM SDBS. The brighter areas around the initial holes indicate that the corrosion proceeds in a layer-by-layer fashion.

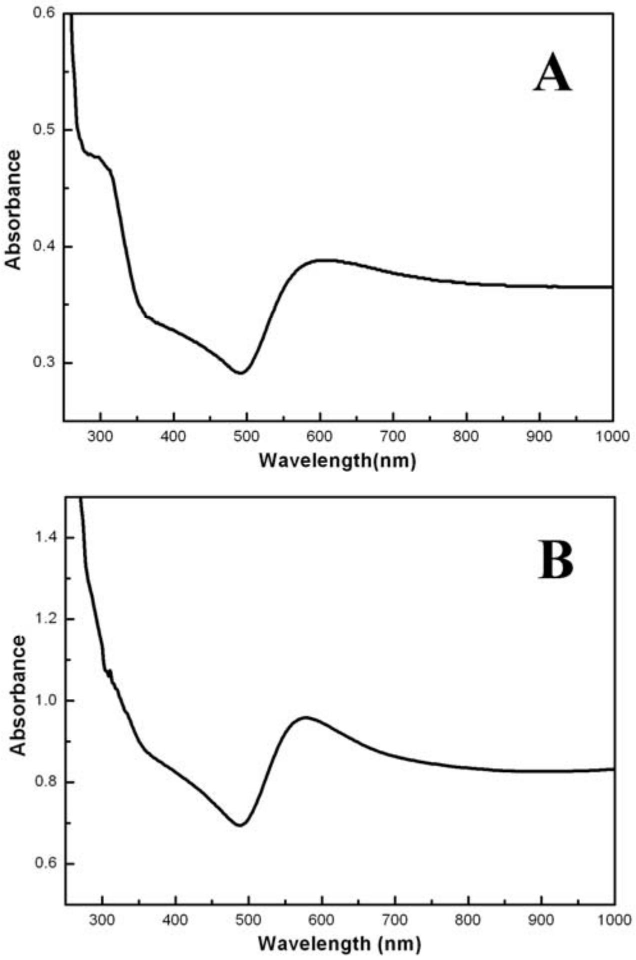

Fig.S4. UV-visible absorption spectra of the aqueous solutions containing 0.5 mM $HAuCl_4$ and 1 mM (A) or 5 mM (B) SDBS after being placed at ambient temperature for one month. The peak around 550 nm is the characteristic absorption peak of gold nanoparticles.