

Supporting information for:

PtPd monolayer on Au nanoparticles deposited on *n*-GaN(0001) for formic acid oxidation

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Experiments

The working electrode of *n*-GaN grown on sapphire(0001) by hydride vapor phase epitaxy. The GaN layer is 5 μm in thickness, Si-doped, and with a carrier concentration of $4 \times 10^{18} \text{ cm}^{-3}$. The working electrode of GaN was cleaned in aqua regia for 1 min, ultrasonicated in acetone and ethanol for 15 min, rinsed in DI water, and dried by nitrogen stream. The effective area of *n*-GaN in contact with electrolyte was 0.5 cm^2 . Pt wires (1 mm in diameter) were used as counter electrodes. All the potentials are reported with respect to the saturated calomel electrode (SCE) reference electrode. Chloroauric acid tetrahydrate ($\text{HAuCl}_4 \cdot 4\text{H}_2\text{O}$), Chloroplatinic acid ($\text{H}_2\text{PtCl}_6 \cdot 6\text{H}_2\text{O}$) Palladium chloride (PdCl_2), Copper sulfate (CuSO_4), Sodium perchlorate (NaClO_4), nitric acid (HNO_3), hydrochloric acid (HCl), sulfuric acid (98% H_2SO_4), formic acid (HCOOH), ethanol, and acetone were of analytical grade and purchased from Sinopharm Chemical Reagent Co., Ltd. All solutions were prepared by using Milli-Q water ($18.2 \text{ M}\Omega$).

The morphology and structure were examined on Tecnai G2 F20 S-Twin transmission electron microscope (TEM) at an acceleration of 200 KV. X-ray photoelectron spectroscopy (XPS) was performed with a KRATOS Axis Ultra-DLD X-ray photoelectron spectrometer with a monochromatised Al $K\alpha$ X-ray ($h\nu = 1486.6 \text{ eV}$). All electrochemical experiments are undertaken at a self-manufactured Teflon cells with a CHI 660D potentiostat/galvanostat (Shanghai ChenHua Co., Ltd.) and used a standard three-electrode cell arrangement.

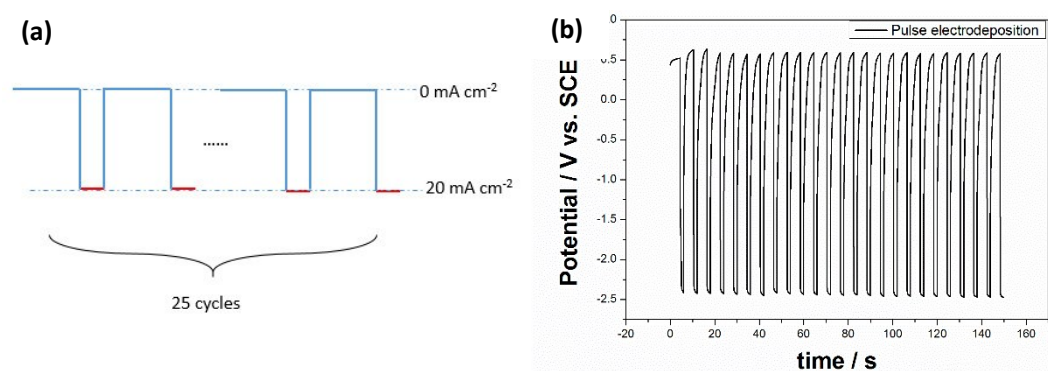


Fig. S1. Scheme (a) and potential-time curve (b) of pulse current deposition. The numbers of pluse is 25, the renewed potential after every pluse electrodeposition could be observed.

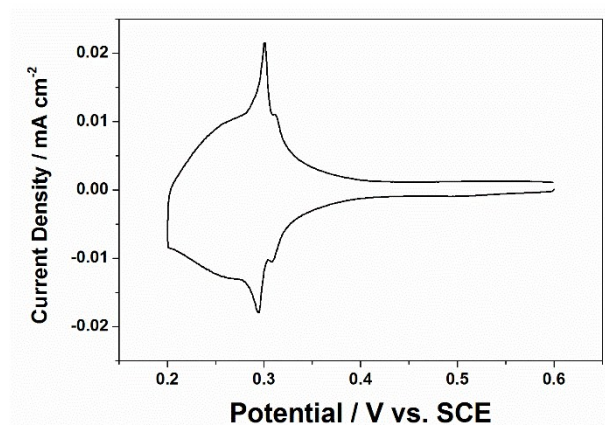


Fig. S2. Typical CV of Au NPs in 0.1 M NaClO₄ + 10 mM CuSO₄ at the sweep of 10 mV/s. The peaks of UPD Cu is similar to the UPD Cu on the I-coated Au surface, both peaks combined to form a large doublet for Cu UPD at 0.3 V. The net Cu UPD coverages for depositions at 0.2 V are very close to a full monolayer.¹⁻³

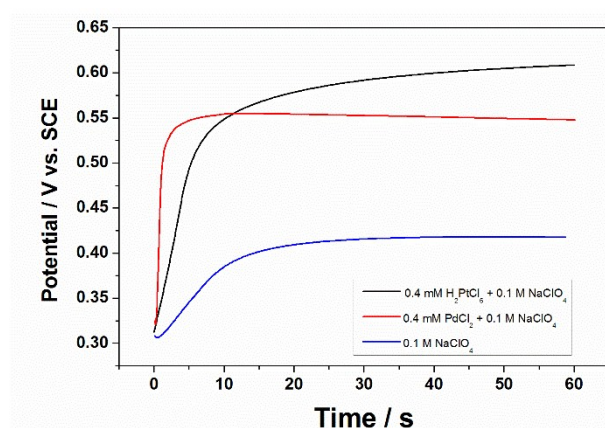


Fig. S3. OCP transients related to the displacement of Cu_{ad} with Pt and Pd atoms in 0.1 M HClO₄ + 0.4 mM H₂PtCl₆ (the black); 0.1 M HClO₄ + 0.4 mM PdCl₂ (the red); potential variations in a control experiment in 0.1 M HClO₄ (the blue).

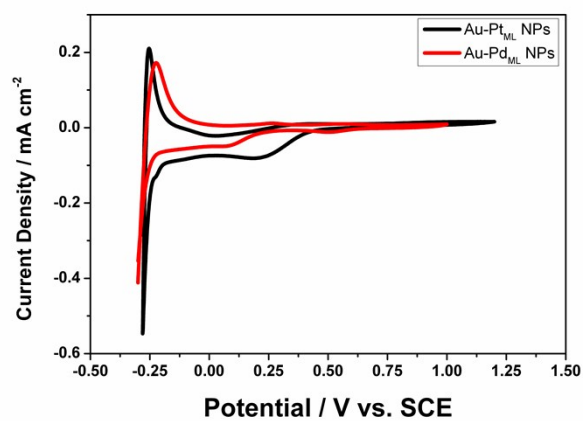


Fig. S4 CVs of Au-Pt_{ML}(black line), Au-Pd_{ML} (red line) in 0.5 M H₂SO₄ at a scan rate of 50 mV/s.

References

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