A simple approach to improve the electrocatalytic properties of commercial Pt/C

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Electronic Supplementary Information

Experimental:

Platinum on graphitised carbon (Pt on C, 20% w/w Pt), chloroauric acid ($HAuCl_4$), ethanol, sodium hydroxide (NaOH) and sulphuric acid (H_2SO_4) were obtained from Sigma-Aldrich and used as-received.

Pt/Au on C was synthesised by immersing 0.5 mg Pt on C powder in 1 mL of an aqueous solution containing 0.5 mM, 1 mM or 1 mM $HAuCl_4$ and allowed to react undisturbed for 30 minutes. After 30 minutes the powder was removed from solution by centrifugation and dried before being resuspended in 1 mL of deionised water (MilliQ).

Electrochemical measurements were obtained at room temperature (22 ± 2 ºC) on a CH Instruments (CHI760C) electrochemical analyser (Ag/AgCl (3M KCl) reference and platinum wire counter electrodes, respectively). The working electrode was a glassy carbon electrode (3 mm diameter BAS) that was polished with an aqueous 0.3 μm alumina slurry on a polishing cloth (Microcloth, Buehler), thoroughly rinsed with Milli-Q water, and dried with a flow of nitrogen gas prior to modification. 20 μL of the catalyst solution was drop cast on to the glassy

carbon electrode and allowed to dry. All experiments were carried out after degassing the electrolyte with N_2 for 10 min.

High Resolution Transmission Electron Microscopy (HRTEM) was performed on a Jeol 2100 TEM operating at 200 kV under high vacuum conditions. A high-sensitivity silicon drift X-ray detector (Oxford XMax) was used for compositional analysis. X-ray Photoelectron Spectroscopy was performed on a Thermo K-Alpha XPS operating at a pressure better than 1 x 10^{-9} Torr with core levels aligned to a C 1s binding energy of 285 eV.

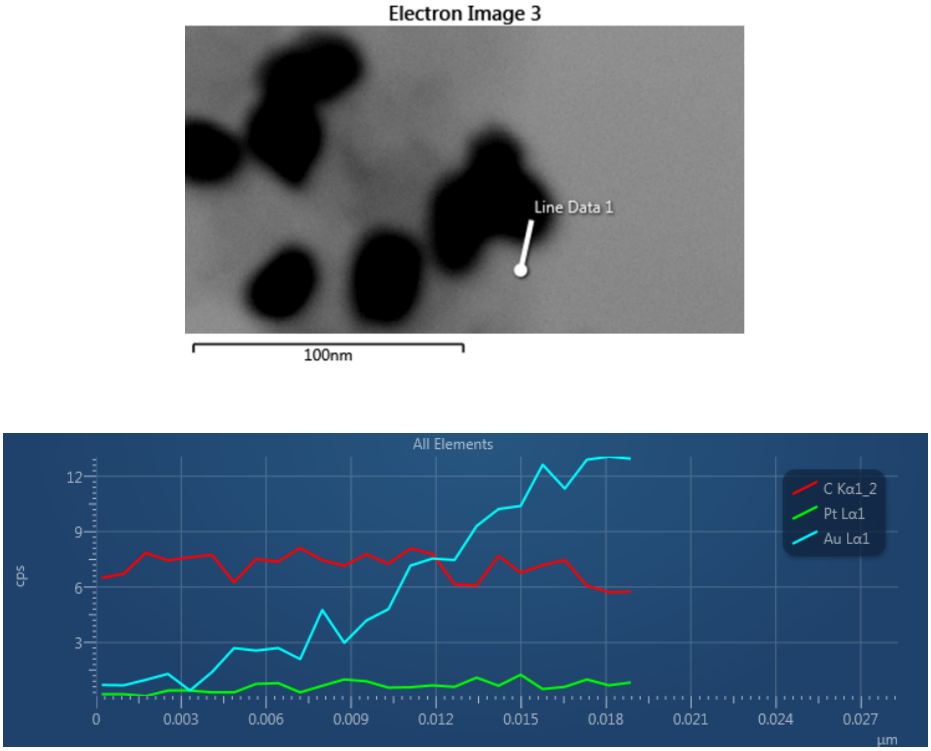

Figure S1: Compositional data taken for the Au/Pt/C sample via EDX analysis illustrating the presence of Au in the larger particles.

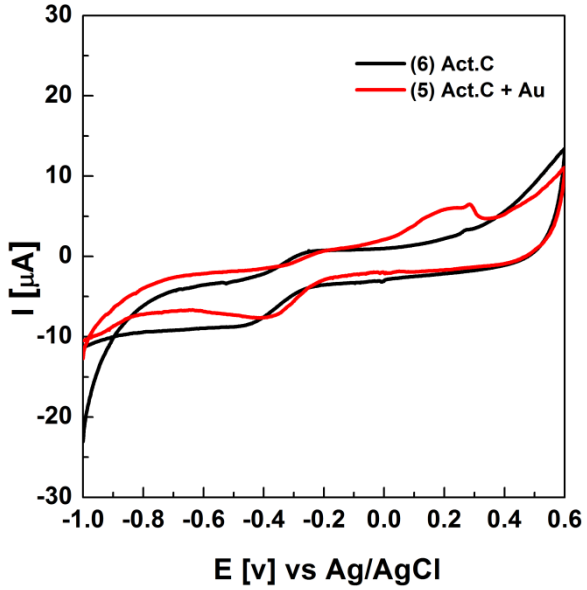

Figure S2: Cyclic voltammograms recorded in 1 M ethanol in 1 M NaOH at 50 mV s^{-1} obtained at Act.C with Au after immersion of Act.C in 1 mM $HAuCl_4$ for 30 min (5) and activated carbon (Act.C) only (6).

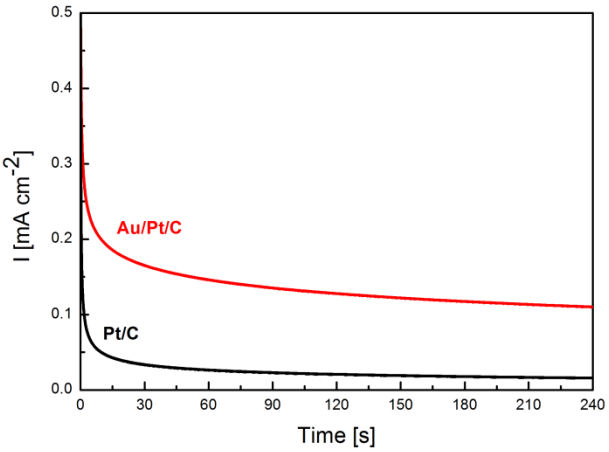

Figure S3: Current versus Time curves for Pt/C (black line) and Au/Pt/C (red line) held at 0.20 V in 1 M ethanol in 1 M NaOH.

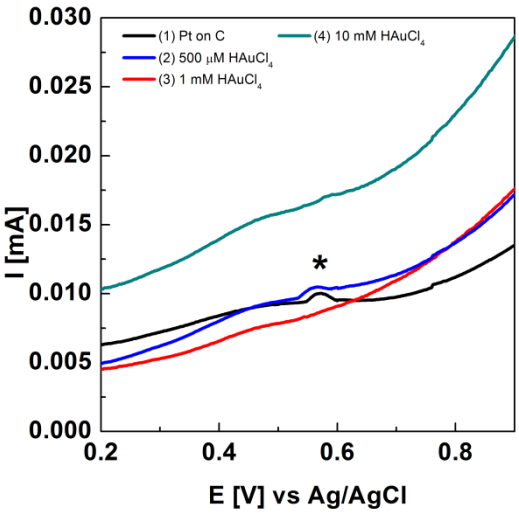

Figure S4: Cyclic voltammograms (zoomed into the double layer region) recorded at 50 mV s^{-1} in 1M H_2SO_4 of commercial Pt on C (1) reacted with 0.5 mM (2), 1 mM (3) and 10 mM (4) $HAuCl_4$ for 30 minutes.

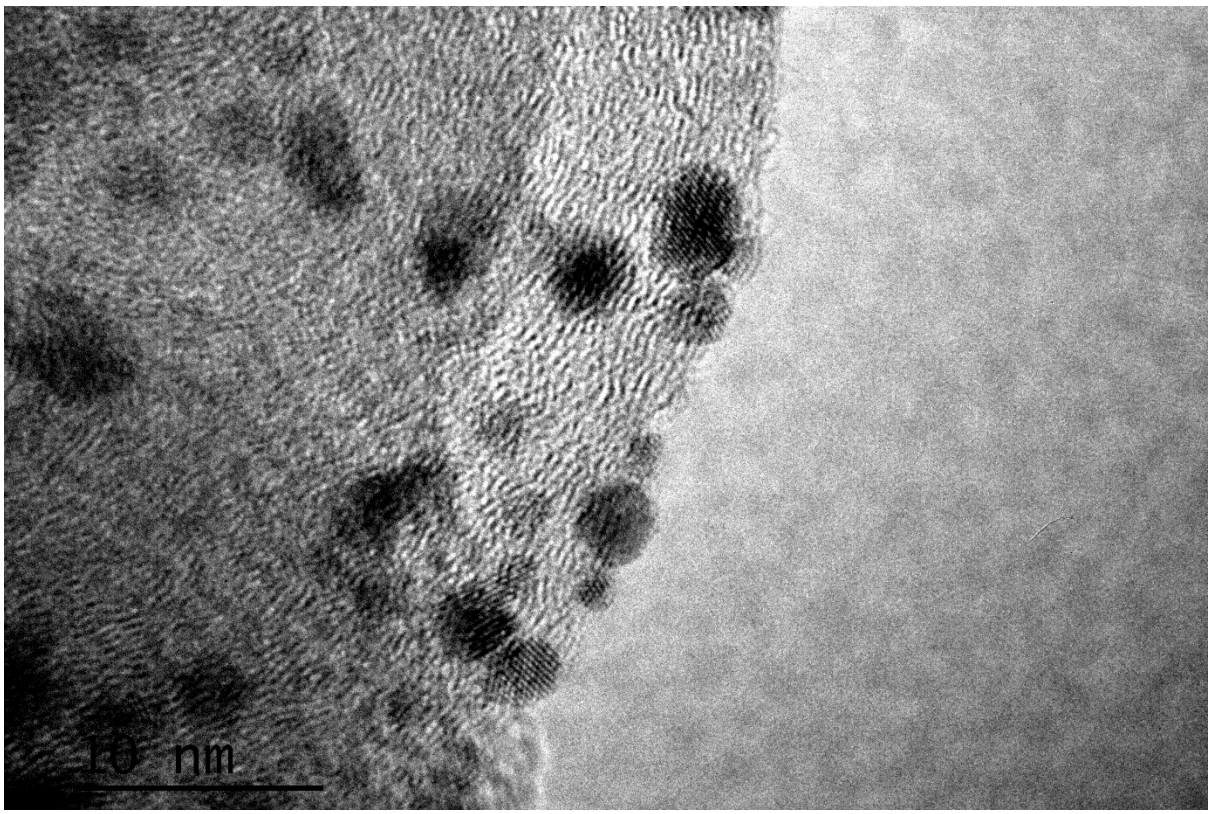

Figure S5: HRTEM images of Au/Pt/C after decoration of Pt/C using 1 mM $HAuCl_4$ for 30 mins.