One Step forward to a Scalable Synthesis of Platinum-Yttrium alloyed Nanoparticles on Mesoporous Carbon for Oxygen Reduction Reaction

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Electronic Supplementary Information

1. Experimental section supporting Information.

The cell glassware and components were soaked in concentrated acid/oxidizing agent (H_2SO_4 Traceselect grade + Nochromix) in large beakers placed in a hood and subsequently were rinsed thoroughly and boiled in deionized (DI) water. Between electrochemical experiments, the glassware and components were stored submerged under DI water.

The ICP-MS was tuned daily using a tuning solution containing 1 μg L^{-1} ^{140}Ce, ^{7}Li, ^{205}Tl, and ^{89}Y (Agilent Technologies, UK). A 100 μg L^{-1} solution of ^{45}Sc and ^{115}In (Aristar, BDH, UK) prepared in HNO_3 1.38% was used as internal standard through addition to the sample solution via a T-junction. Multielement standard solutions for calibration were prepared by gravimetric serial dilution at six different concentrations (from 10 μg L^{-1} to 500 μg L^{-1}) obtained using as solvent a 5:1 HNO_3/HCl mixture diluted to 5% by weight. All regressions were linear with a correlation coefficient (R^2) larger than 0.9999.

Multi-element calibration standard-1, 100 mL: 10 mg/L of Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sc, Sm, Tb, Th, Tm, Y, Yb; matrix 5% HNO_3 Cod: 8500-6944 (Agilent Technologies, UK). Multi-element calibration standard-3, 100 mL: 10 mg/L of Sb, Au, Hf, Ir, Pd, Pt, Rh, Ru, Te, Sn; matrix 10% HCl/1% HNO_3 Cod: 8500-6948 (Agilent Technologies, UK).

A microwave acidic digestion was performed with a CEM EXPLORER SP-D PLUS. 5 mg of samples (Pt_xY@MC) was weighed and digested in 7 g of mixture 1:1 HNO_3/HCl according to the following microwave acid mineralization procedure: ramp temperature from room to 220 °C in 10 min, then 220 °C for 3 min, pressure 400 PSI, power 300 W and stirring “medium”. The solutions were diluted with the same solvent used for calibrations.

2. Figures.

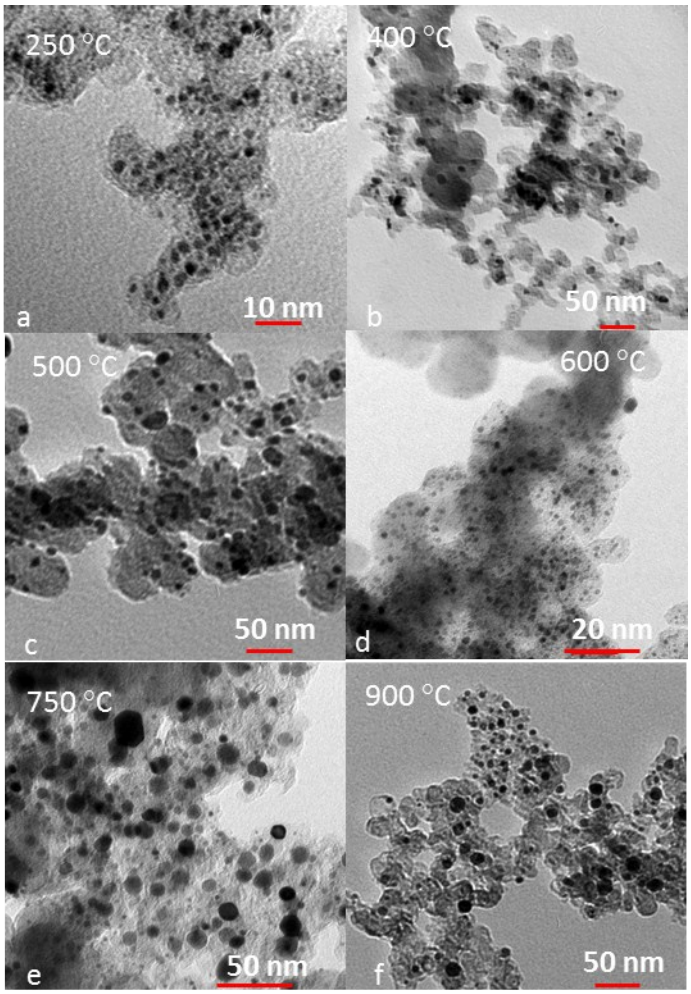

Figure S1. TEM images of Pt_xY samples obtained from the co-reduction of $PtCl_2$ and $Y(NO_3)_3$ on mesoporous carbon at different temperatures.

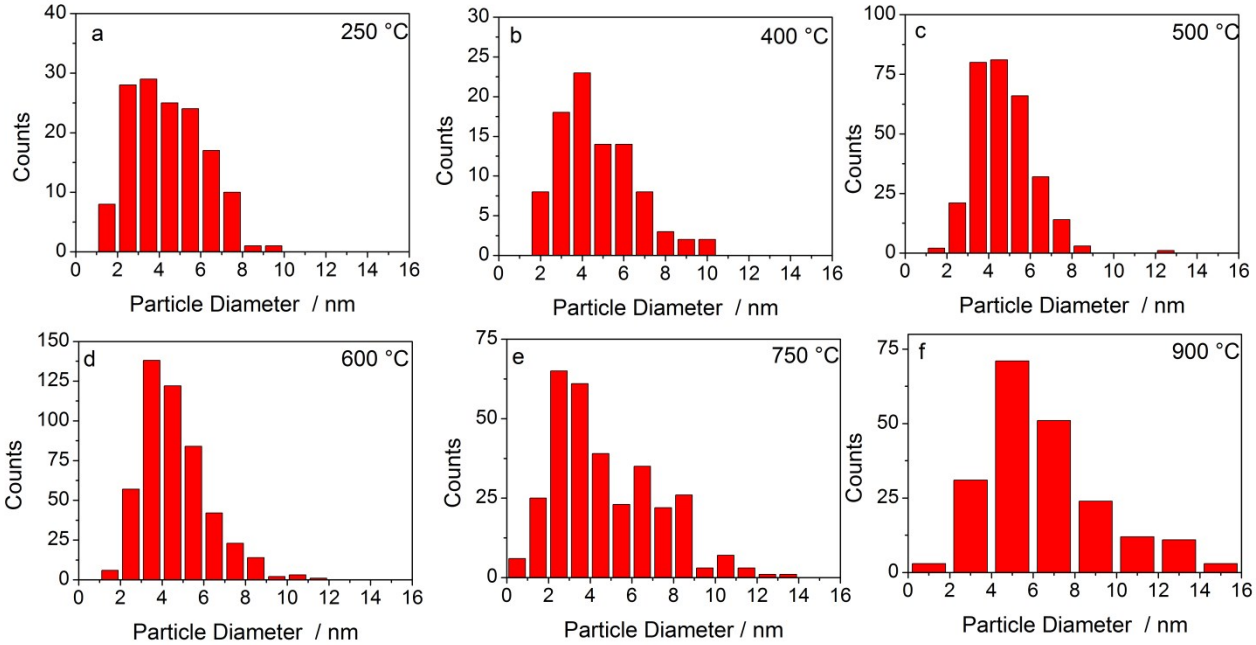

Figure S2. Pt_xY particle size distribution for catalysts obtained from co-reduction of $PtCl_2$ and $Y(NO_3)_3$ on mesoporous carbon at different temperatures.

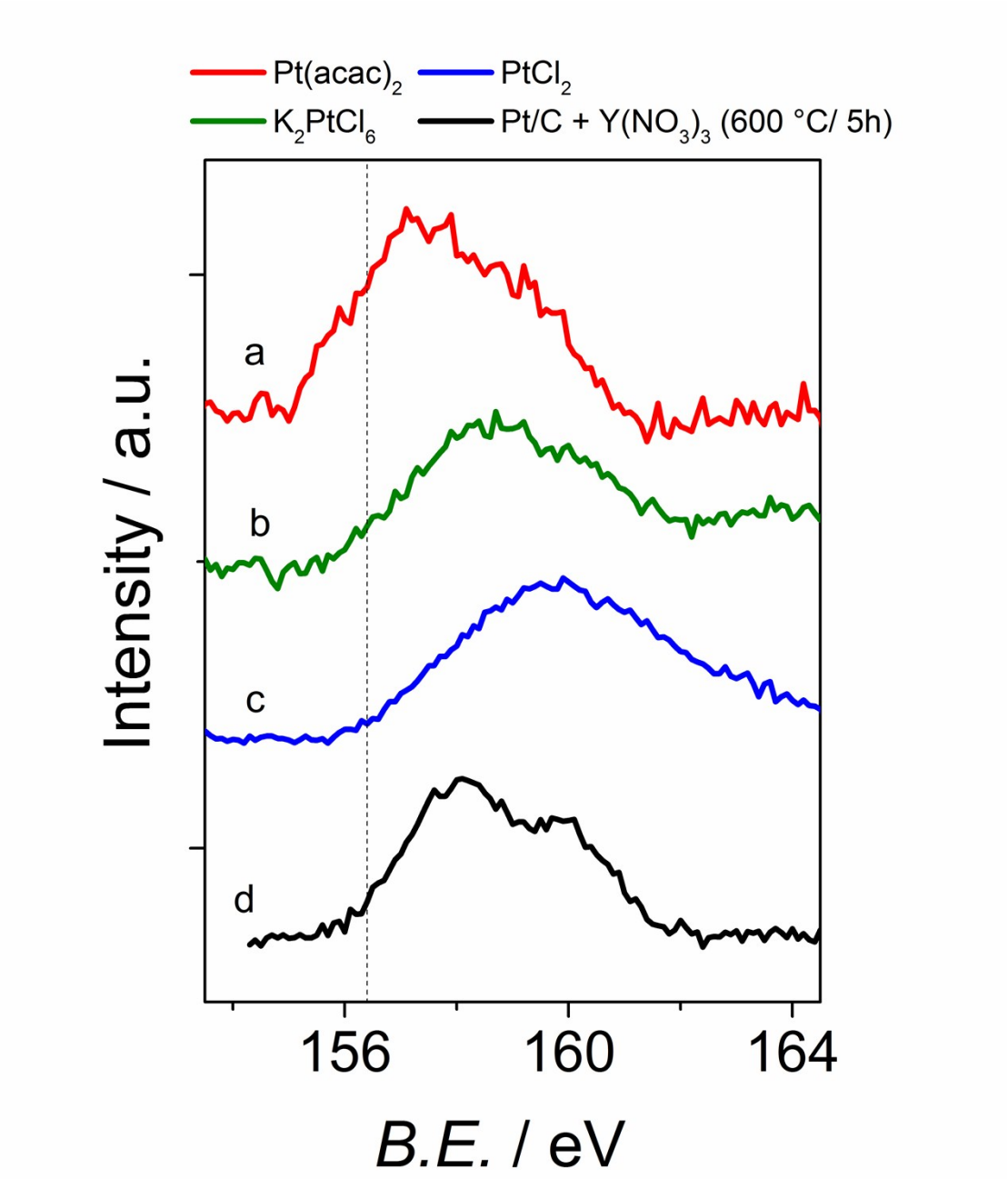

Figure S3. Y 3d XPS feature of Pt_xY samples obtained from a) $Pt(acac)_2$, b) K_2PtCl_6, c) $PtCl_2$ and $Y(NO_3)_3 \cdot 6H_2O$ at 600 °C for 3 hours; d) Pt/C (Pt 30% on Vulcan) and $Y(NO_3)_3 \cdot 6H_2O$ at 600 °C for 5 hours

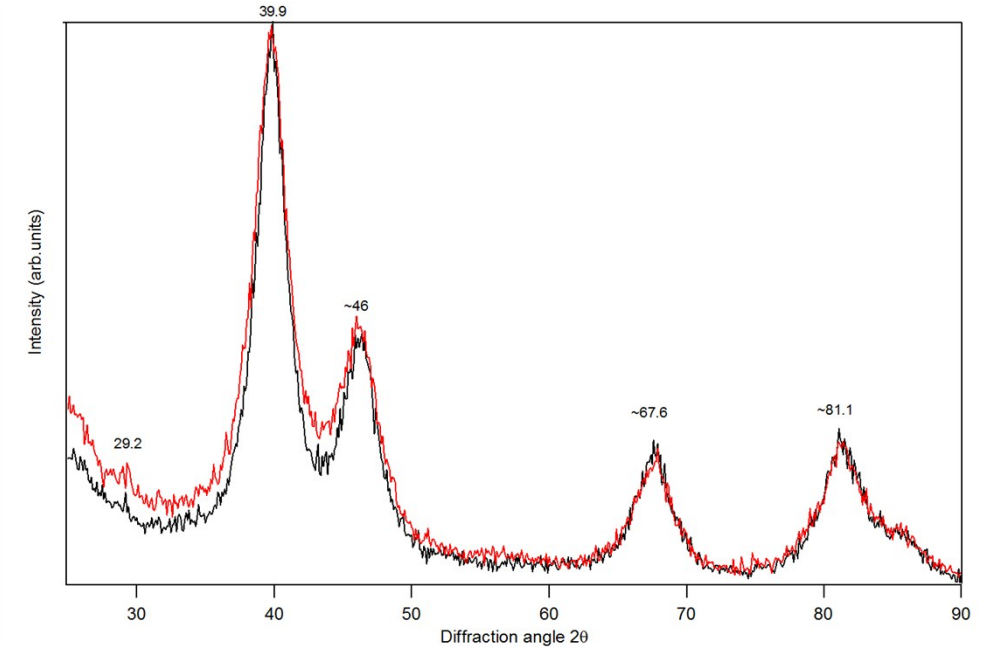

Figure S4. XRD spectra of $Pt_xY600h5$ (red curve)) compared with that of pure Pt NPs (black curve).

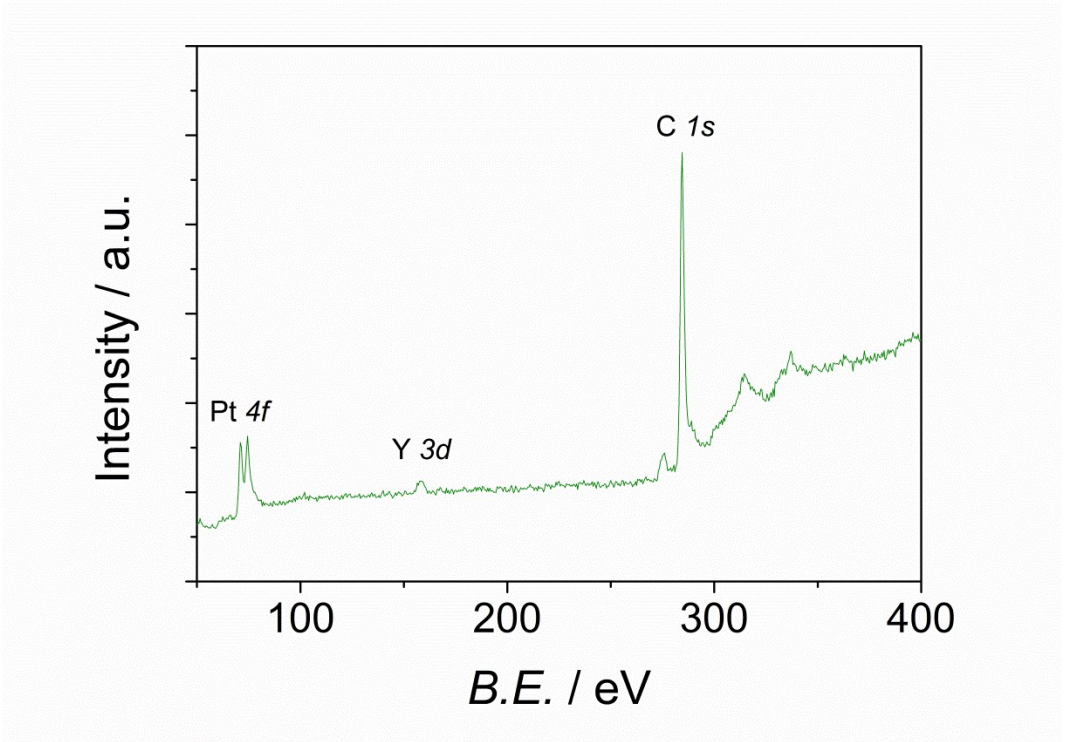

Figure S5. XPS survey of $Pt_xY600h5$

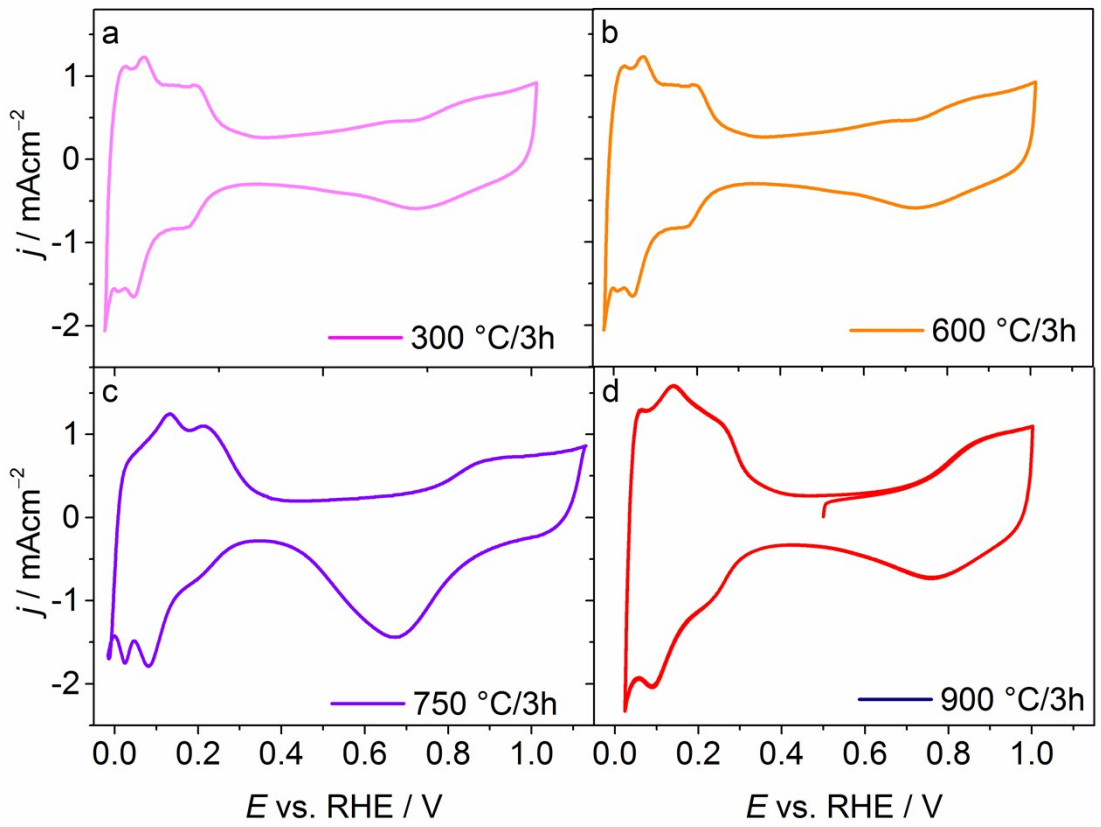

Figure S6. Cyclic voltammograms of different Pt_xY catalysts. CVs recorded at scan rate of 50 mV s^{-1} in Ar purged 0.1 M $HClO_4$ at 25 °C.