

## Supplementary Information

### Pt-grown carbon nanofibers for detection of hydrogen peroxide

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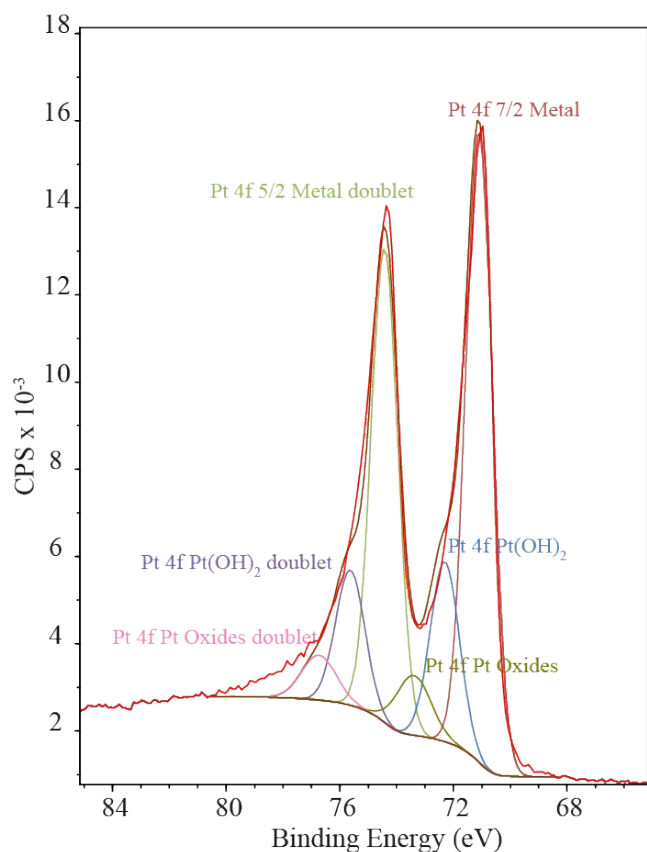
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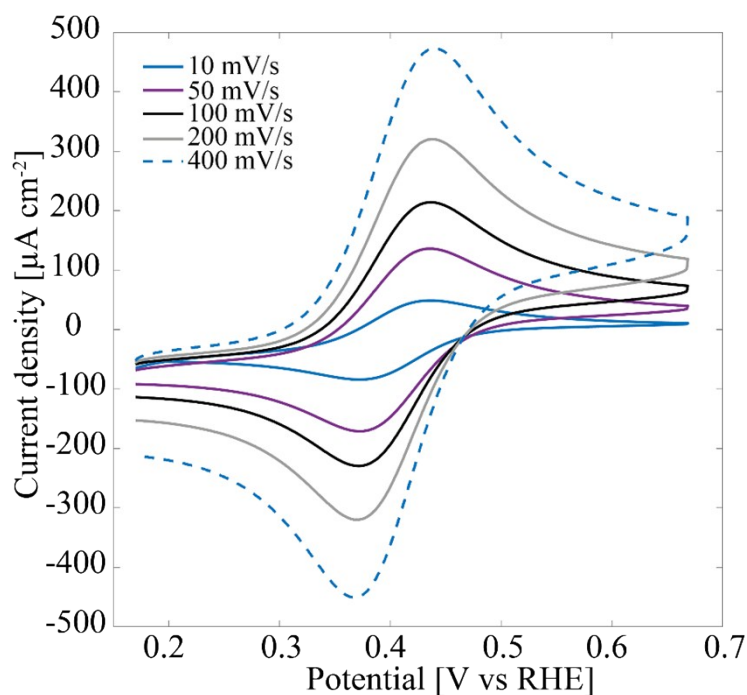
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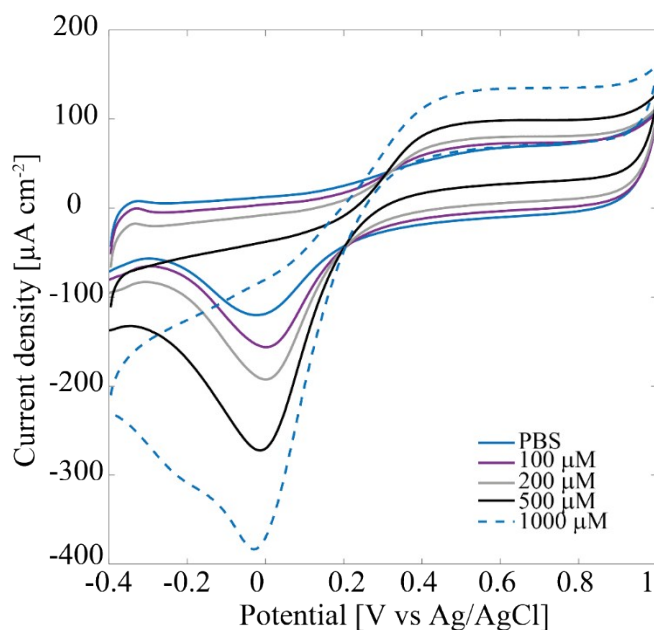
**Figure S1. Fitted Pt 4 f doublet from the XPS spectrum.**

The Pt 4f spectrum recorded from the Pt-CNF sample was fitted to estimate the amount of metallic and oxidized Pt species (Figure S1). Peak positions for metallic Pt and the Pt doublet were 71.1 eV and 74.4 eV, respectively. The Pt(OH)<sub>2</sub> and its corresponding doublet peak were fitted at 1.2 eV above the metallic and metal doublet peaks. Pt oxides were fitted at 2.4 eV above the metallic line. Based on the fit it can be estimated that at least 75% of the Pt in the samples is in its metallic form and the remaining 25% in the form of different Pt oxides, mainly as Pt(OH)<sub>2</sub>. Peak positions were estimated from following publications: Hammond & Winogard<sup>1</sup>, Aricò *et al.*<sup>2</sup> and Wagner *et al.*<sup>3</sup>.



**Figure S2.** ND-CNFs show (pseudo) reversible electron transfer kinetics with  $\Delta E_p$  increasing from 62 mV for scan rate of 10 mV/s to 69 mV for scan rate of 400 mV/s. In order to make it easier to compare with Figure 2 in the original manuscript the graph here is presented in RHE scale even though the original measurements was performed against Ag/AgCl/KCl sat'd.

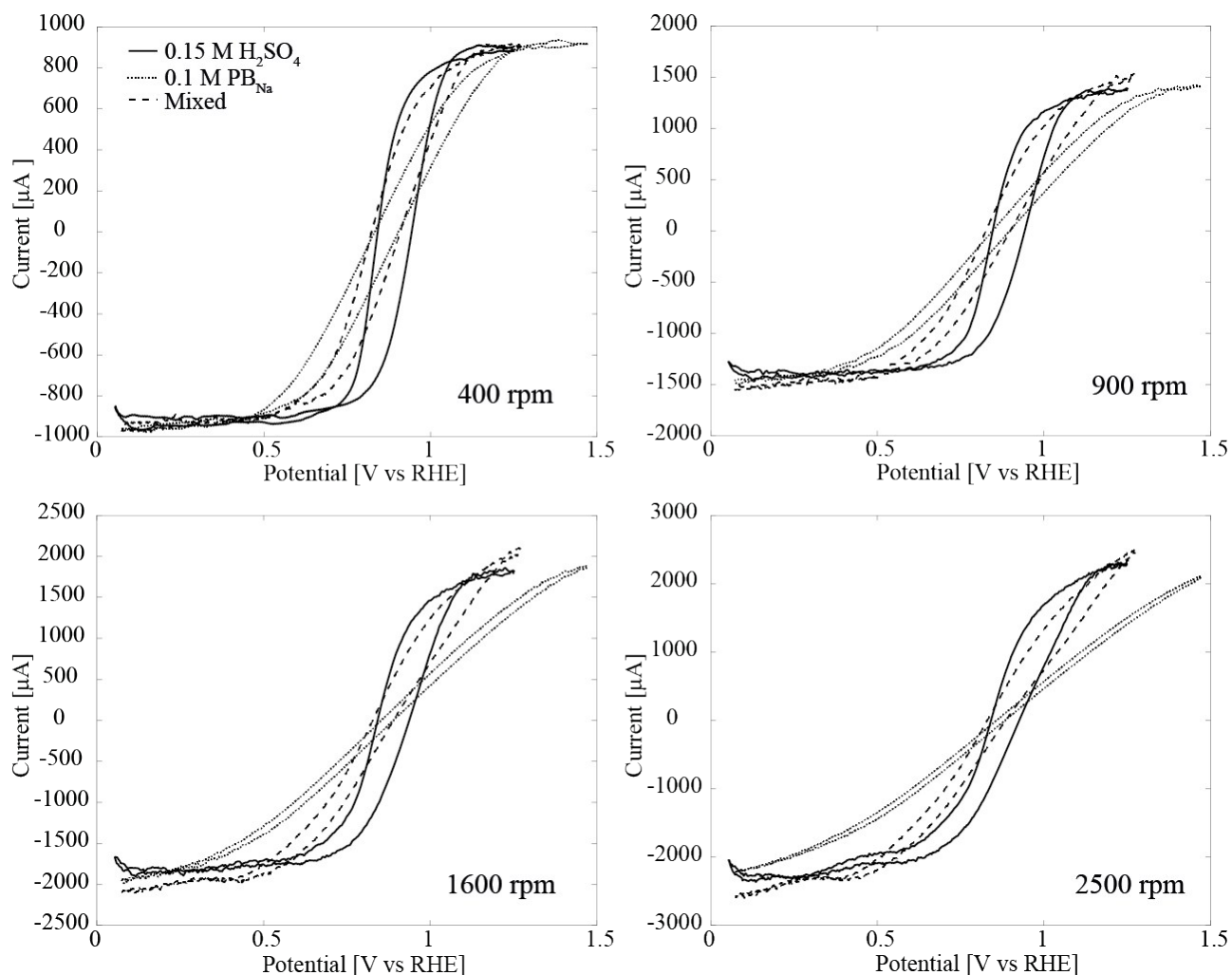
Figure S2 show the characterization of nanodiamond-grown carbon nanofibers (ND-CNFs) with 1 mM hexaammineruthenium(III) chloride in 1 M KCl. The utilization of Randles-Sevcik equation for evaluation of the active surface area was justified as the ND-CNFs show nearly reversible behavior with  $\Delta E_p$  increasing from 62 mV for scan rate of 10 mV/s to 69 mV for scan rate of 400 mV/s.



**Figure S3.** When  $\text{H}_2\text{O}_2$  is added into the  $\text{N}_2$ -purged PBS at high concentrations ( $1000 \mu\text{M}$ ) an additional peak appears at approximately  $-0.2 \text{ V vs. Ag/AgCl}$  with Pt-CNFs. The concentration of  $\text{H}_2\text{O}_2$  has to be higher in degassed than in non-degassed PBS which supports the suggestions that 1) the peak arises from  $\text{O}_2$  generated from  $\text{H}_2\text{O}_2$  and 2) there exist some threshold concentration of  $\text{H}_2\text{O}_2/\text{O}_2$  for the peak to appear. Similar peak does not emerge in phosphate buffers that do not contain chlorides and thus this peak could be related to ORR.

When cycling the potential of the samples in  $\text{N}_2$ -purged PBS containing large amounts ( $1000 \mu\text{M}$ ) of  $\text{H}_2\text{O}_2$ , an additional peak appeared approximately at  $-0.2 \text{ V vs. Ag/AgCl}$  in the voltammogram (Figure S3). In non-deaerated (initially  $\text{O}_2$ -containing) PBS the peak appeared already with addition of  $500 \mu\text{M H}_2\text{O}_2$ .

Figure S4 shows the RDE experiments with Pt-CNFs without post  $iR$  correction for the phosphate buffer ( $R_u = 100 \Omega$ ). It can be seen that the resistivity of the solution has an effect on the shape of the curve in both anodic and cathodic ends. The effect becomes more pronounced when the rotation rate is increased.



**Figure S4.** RDE experiments (50 mV/s) with Pt-CNFs at 400 rpm, 900 rpm, 1600 rpm and at 2500 rpm in 0.15 M  $\text{H}_2\text{SO}_4$ ,  $\text{PB}_{\text{Na}}$  and mixed solution of phosphate buffer and  $\text{H}_2\text{SO}_4$  with 5 mM  $\text{H}_2\text{O}_2$  without post iR correction. To take the pH difference into account the graphs are presented in RHE scale even though the original measurements were performed against Ag/AgCl/KCl sat'd. Conversion was done by utilizing Nernst equation taking into account solution pH.

## References

- 1 J. S. Hammond and N. Winograd, XPS Spectroscopic Study of Potentiostatic and Galvanostatic Oxidation of Pt Electrodes in  $\text{H}_2\text{SO}_4$  and  $\text{HClO}_4$ , *J. Electroanal. Chem. Interfacial Electrochem.*, **1977**, 78, 55–69.
- 2 A. S. Aricò, A. K. Shukla, H. Kim, S. Park, M. Min and V. Antonucci, XPS Study on Oxidation States of Pt and Its Alloys with Co and Cr and Its Relevance to Electroreduction of Oxygen, *Appl. Surf. Sci.*, **2001**, 172, 33–40.
- 3 C. D. Wagner, W. M. Riggs, L. E. Davis and J. F. Moulder, *Handbook of X-ray Photoelectron Spectroscopy*, Perkin-Elmer Corporation, Eden Prairie, MN, **1978**.