Electronic Supplementary Information

Platinum Decorated Functionalized Defective Acetylene Black; A Promising Cathode Material For Oxygen Reduction Reaction

B. Rajashekar, R. Vedarajan and N. Matsumi
School of Materials Science, Japan Advanced Institute of Science and Technology, Nomi, Ishikawa 923-1292, Japan.

Single pot method for exfoliation and functionalization of acetylene black:

1 gm. of acetylene black (AB) was taken in a round bottom flask, to this around 10ml of 3:1 H_2SO_4 and HNO_3 was added in a way, such that the entire amount of AB was immersed completely in the acid mixture. The solution was ultrasonicated for 3hrs at room temperature. The solution was poured in to 100ml of distilled water and the mixture was filtered using nylon filter membrane with 0.1μm pore size. The filtrate was copiously washed with distilled water to remove the acidic contaminants, further the content was washed with methanol and air dried for few minutes. This was then dried at 100 ^oC in a vacuum oven for 2 hrs to get functionalized acetylene black (FAB).

Preparation of Pt-FAB:

Chemical reduction method was used for the decoration of Pt nanoparticles (Pt-np) on the surface of FAB. In this method 90 mg of FAB was added to a round bottom flask containing 3.27 ml aqueous solution of 0.0443 M H_2PtCl_6, 8.84 ml of DI water and 40 ml ethylene glycol. This mixture was ultrasonicated for 4hrs to ensure uniform dispersion of FAB in ethylene glycol–water solution. After the FAB was uniformly dispersed in the ethylene glycol – water mixture, it was heated at 120 ^oC for 24hrs with constant stirring. Finally, the 10% (wt/wt) Pt–np decorated FAB (10 wt% Pt-FAB) was filtered using 0.1 μm pore sized nylon membrane under vacuum and washed with water and methanol. Then the filtrate was dried under vacuum at 100 ^oC for 2 hrs.

X-ray photo electron spectroscopic (XPS): The following are the deconvoluted C1S spectra of AB, FAB and 10wt%Pt-FAB

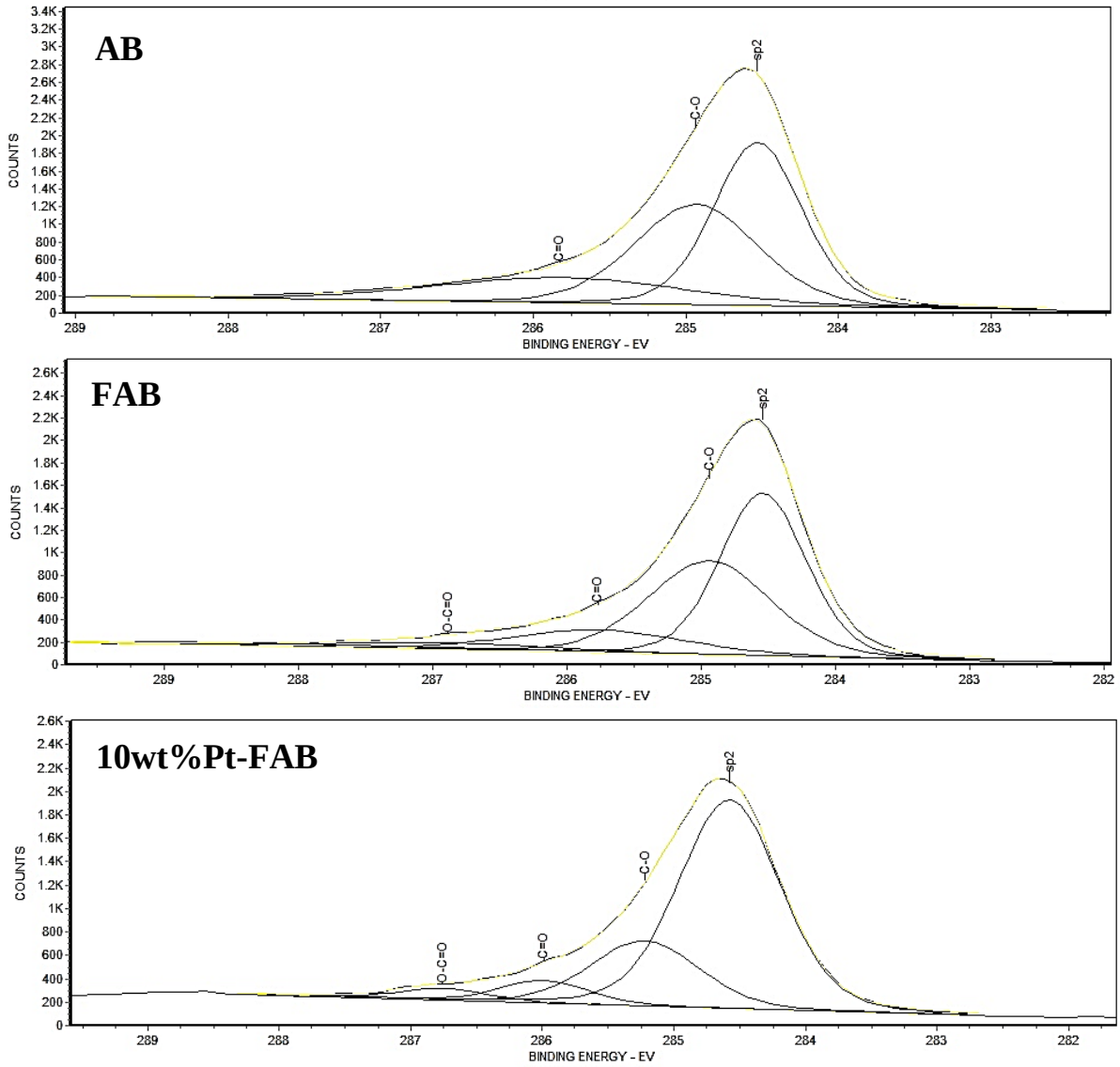

Fig ESI 1

Ink preparation: 10 mg of as prepared carbon material (AB, FAB or Pt-FAB) was taken and dispersed into 60 µL of distilled water to this 40 µL of isopropylealcohol was added along with 15 µL of Nafion® and was sonicated to get a well dispersed ink. 10 µL of the prepared ink was coated on GC to form a thin film for all the electrochemical characterizations.

TEM Micrographs of Pt-AB and Pt-Vulcan XC-72:

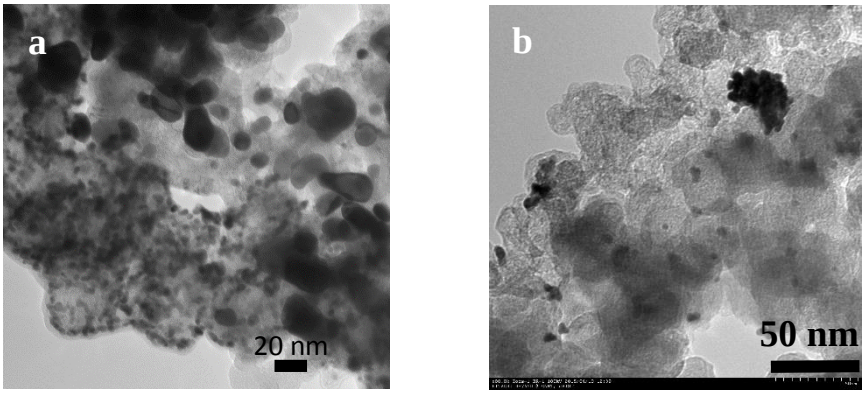

Fig ESI 2: a) TEM of Pt-AB and b) Pt-Vulcan XC-72

Electrocatalytic ORR activity and Electrochemical Surface Area (ECSA) calculation: The following is the equation[7] with which the ECSA was calculated.

$$ECSA = \frac{\text{Charge } [Q_H\ \mu C/cm^2]}{210[\mu C/cm^2] \text{ X Pt loading } [g/cm^2]}$$

Columbic efficiency:

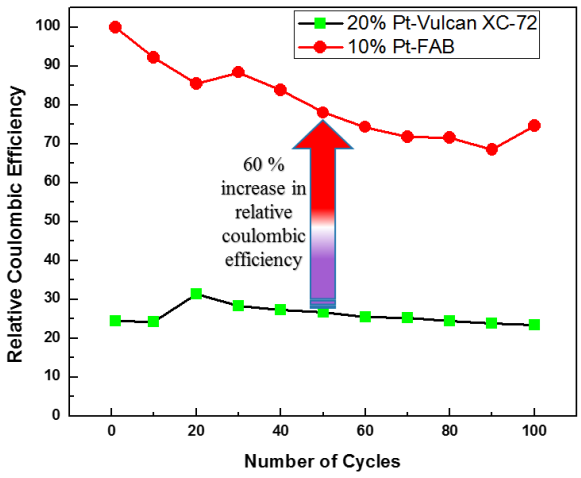

Fig ESI 3

EDS:

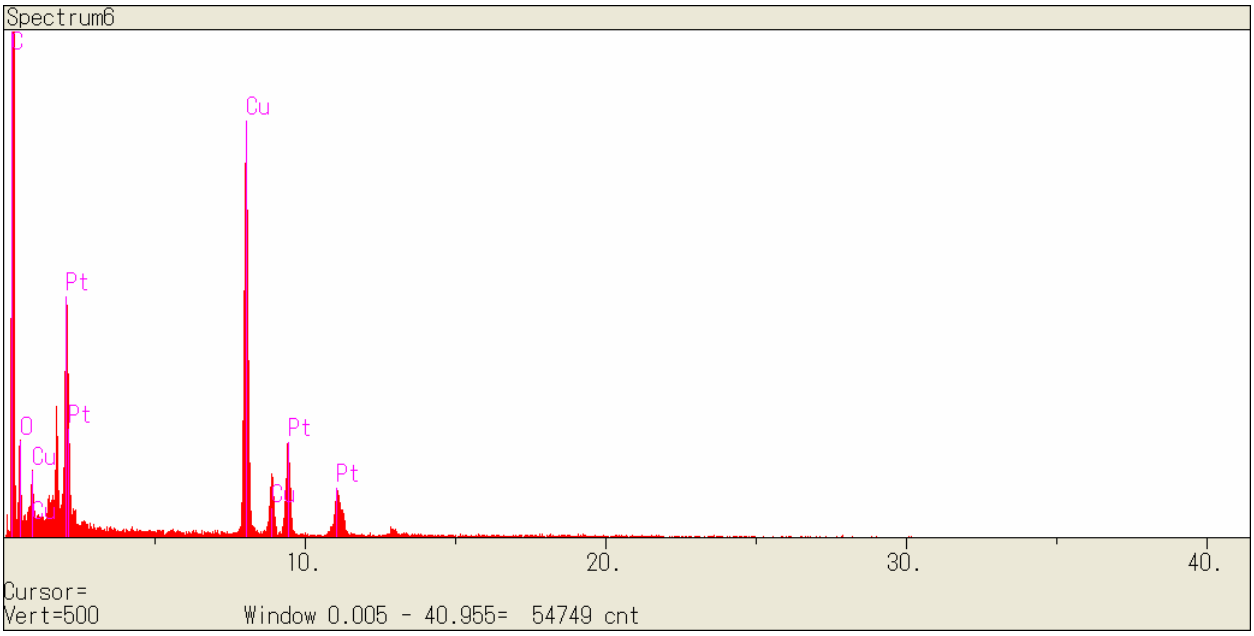
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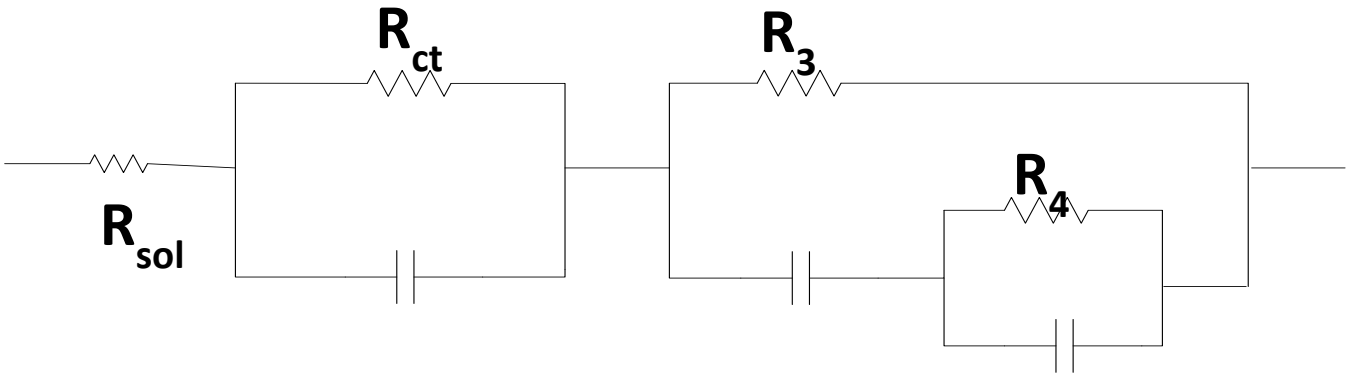
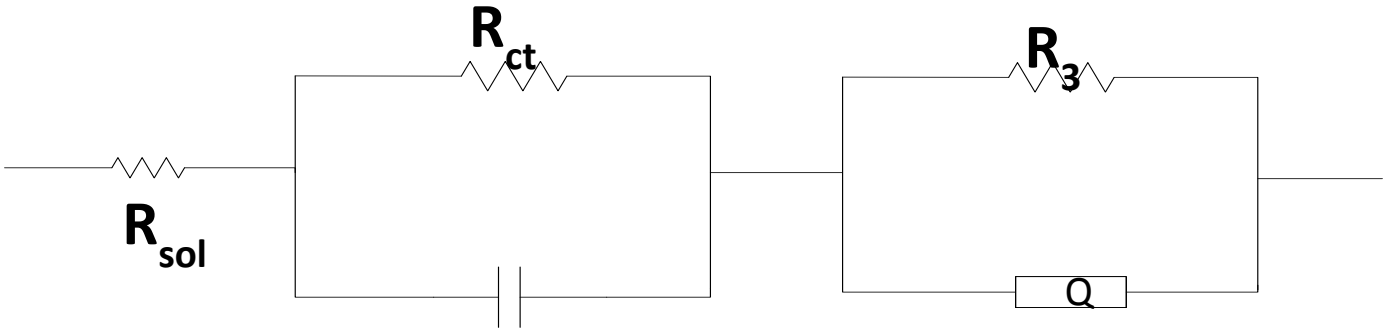
Fig ESI 4

Equivalent Circuits:

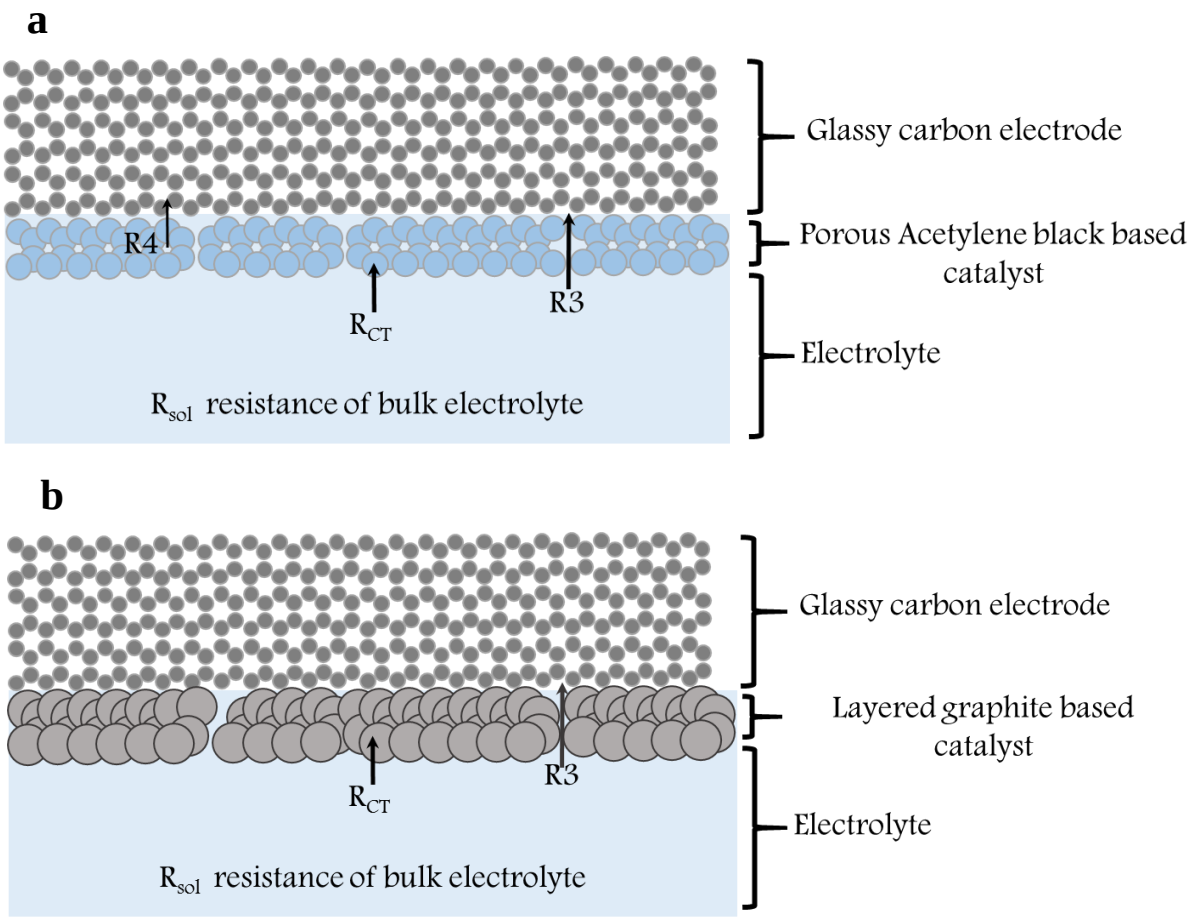


AB, FAB and Pt-FAB



20% Pt-Vulcan XC 72

Fig ESI 5



ESI 6a, b Pictorial representation explaining the elements of equivalent circuit for 10wt%Pt-FAB and 20wt%Pt-Vulcan XC 72.