Supplementary Material (ESI) for Journal of Materials Chemistry
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# *Electronic Supplementary Information (ESI) for*

# Facile Synthesis of Nitrogen-doped Carbon/Pt Nanoparticle Hybrids via Carbonization of Poly(1-butyl-3-vinylimidazolium bromide-co-acrylonitrile) for Electrocatalytic Oxidation of Methanol

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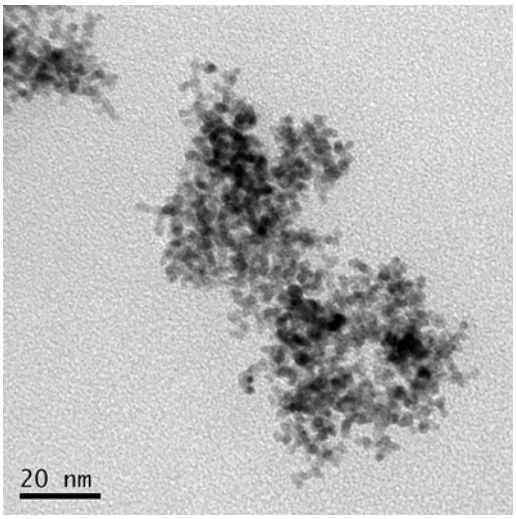


**Figure S1.** TEM images of synthesized Pt NPs. Reaction conditions: 1.0 mL $H_2PtCl_6$ (30 mM), 4.5 mL $NaBH_4$ (40 mM), 25 mg PVP and 18 mL water.

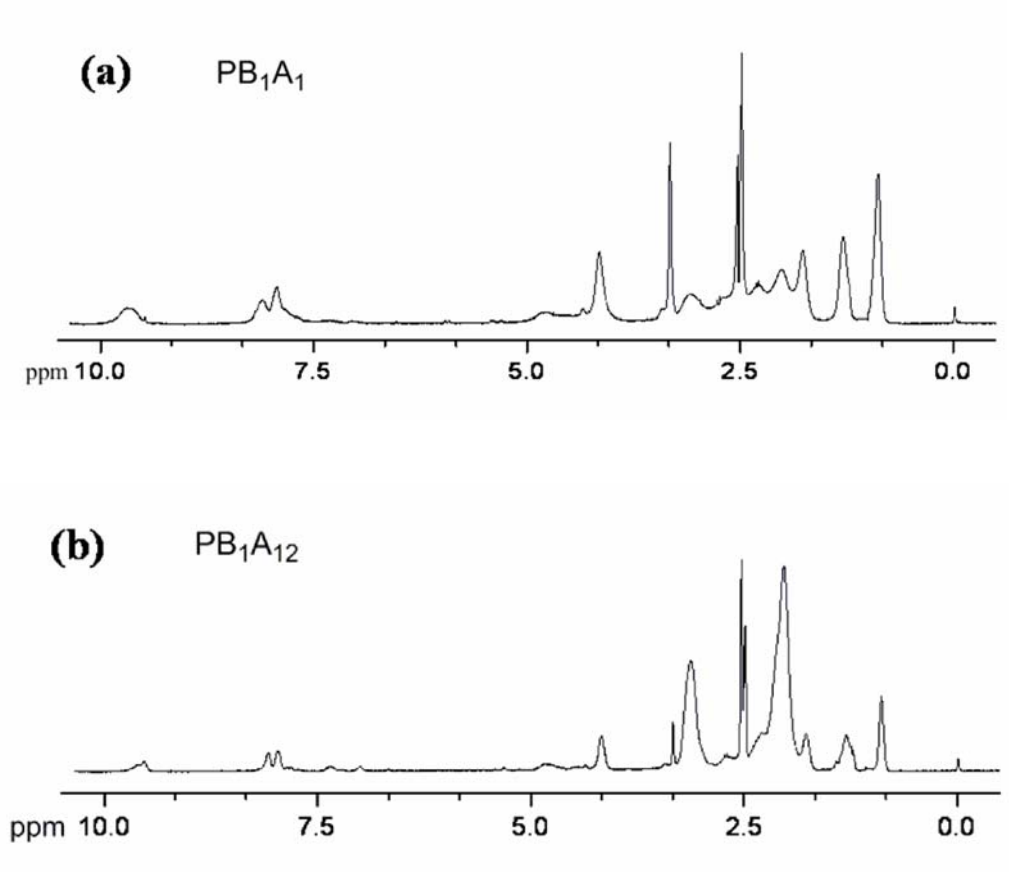


**Figure S2.** $^1$H-NMR spectra for (a) $PB_1A_1$, (b) $PB_1A_{12}$.

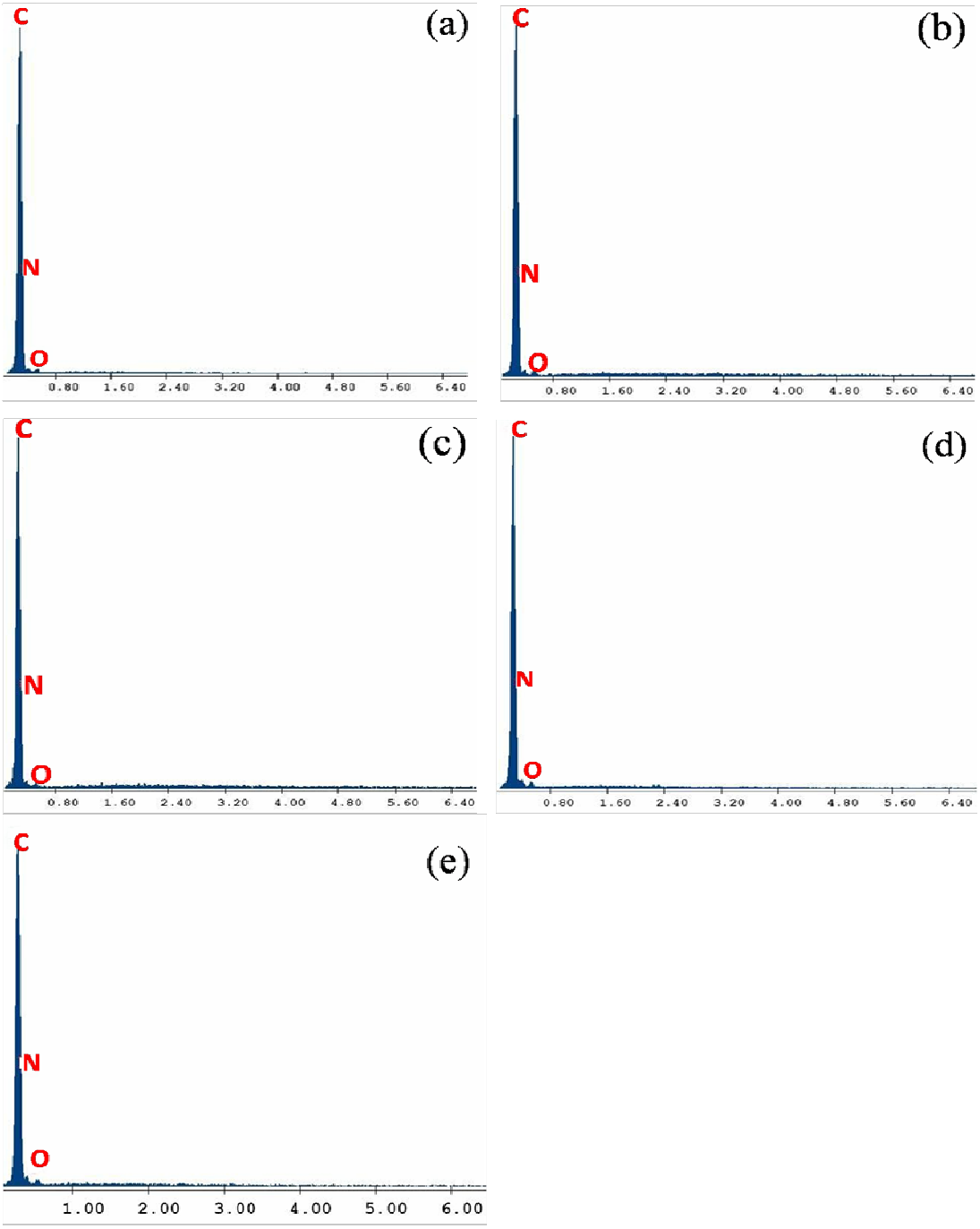


**Figure S3.** EDS of N-doped carbon materials derived from (a) PILs, (b) $PB_1A_1$, (c) $PB_1A_4$, (d) $PB_1A_{12}$ and (e) PAN. (Conditions: ramp rate = 10 $^oC$ $min^{-1}$, temperature = 800 $^oC$, dwell time = 1 h).

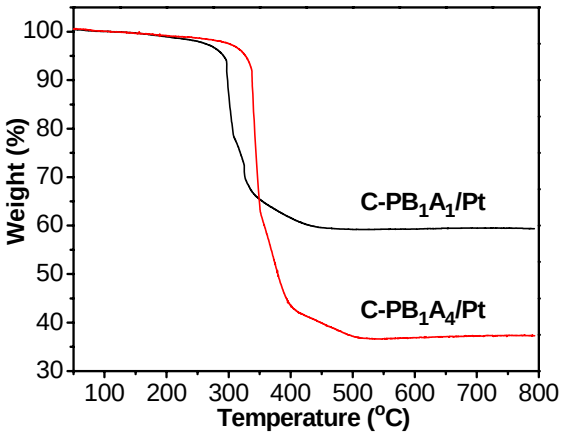


**Figure S4.** TGA curves to determine Pt loading in the two Pt loaded carbon samples.

The Pt loading was determined by TGA of samples under air atmosphere. As shown in Figure S4 that about 59.0 and 39.6 wt% Pt nanoparticles were loaded in the sample of C-$PB_1A_1$/Pt and C-$PB_1A_4$/Pt, respectively.

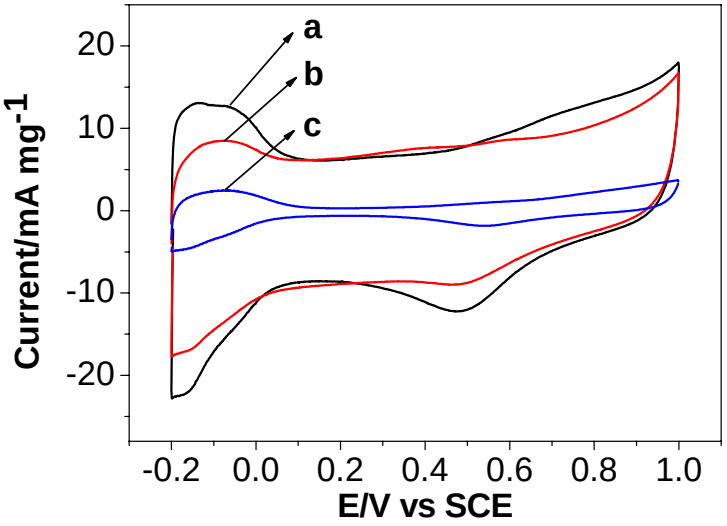


**Figure S5.** CVs of nitrogen-doped C/Pt nanohybrids and pure Pt NPs modified electrodes in $N_2$-saturated 0.5 M $H_2SO_4$ solution at a scan rate of 50 mV $s^{-1}$, a) C-$PB_1A_1$/Pt, b) C-$PB_1A_4$/Pt, c) pure Pt NPs.

The ECSA value can be measured by integrating Coulombic charge for hydrogen adsorption-desorption from the cyclic voltammograms shown in Figure S5 according to the following equation:[1,2]

$$ECSA = \frac{Q_H}{0.21 \times L_{Pt}}$$

where $Q_H$ (mC.cm$^{-2}$) represents the mean value between the amounts of charge exchanged during the electro-adsorption and desorption of $H_2$ on Pt sites, $L_{Pt}$ is the Pt loading (mg/cm$^2$) on the GC electrode (0.0707 cm$^2$ in geometric area) and 0.21 (mC.cm$^{-2}$) represents the charge required to oxidize a monolayer of $H_2$ on Pt. The loading mass of Pt nanoparticles on the GC of C-PB$_1$A$_1$/Pt, C-PB$_1$A$_4$/Pt was determined by thermogravimetric analysis (TGA). From Figure S5, the ECSA values of the two catalysts (C-PB$_1$A$_1$/Pt, C-PB$_1$A$_4$/Pt) were calculated and summarized in Table S1.

Table S1. Hydrogen adsorption and desorption charges and the electrochemical surface area (ECSA) of the two catalysts

| Catalysts | $L_{Pt}$ (μg.cm$^{-2}$) | $Q_H$(mC.cm$^{-2}$) | ECSA[m$^2$/g Pt] |
|---|---|---|---|
| C-PB$_1$A$_1$/Pt | 99.71 | 6.94 | 33.14 |
| C-PB$_1$A$_4$/Pt | 66.93 | 3.53 | 25.10 |

## Reference:

1. A. Pozio, M. De Francesco, A. Cemmi, F. Cardellini, L. Giorgi, *J. Power Sources*, 2002, **105**, 13-19.

2. E. P. Lee, Z.M. Peng, D. M. Cate, H. Yang, C. T. Campbell, and Y. N. Xia, *J. Am. Chem. Soc.*, 2007, **129**, 10634–10635.