

Supporting Information

Carbonization of Ionic Liquid Polymer-functionalized Carbon Nanotubes for High Dispersion of PtRu Nanoparticles and Their Electrocatalytic Oxidation of Methanol

Bohua Wu,^{a,‡} Yinjie Kuang,^{a,b,‡} Yunsong Zhang,^a Xiaohua Zhang^a

and Jinhua Chen^{a,*}

^a State Key Laboratory of Chemo/Biosensing and Chemometrics, College of Chemistry and
Chemical Engineering, Hunan University, Changsha, 410082, P.R. China

^b Hunan Provincial Key Laboratory of Materials Protection for Electric Power and
Transportation, School of Chemistry and Biological Engineering, Changsha University of Science
& Technology, Changsha, 410114, P.R. China

1. FT-IR Characterization of Pristine CNTs and CNTs-PIL

Surface-functionalization of CNTs with ionic liquid polymer was characterized by Fourier transform infrared (FT-IR) spectroscopy. The FT-IR spectra of 1-vinyl-3-ethyl imidazolium bromide ([VEIM]Br), pristine-CNTs and CNTs-PIL are shown in *Fig. S1*. The pristine CNTs show typical absorption peaks of aromatic rings from 1600 cm⁻¹ to 1450 cm⁻¹ (curve 1 in *Fig. S1*). In the FT-IR spectrum of [VEIM]Br (curve 2 in *Fig. S1*), the peaks at 3072 and 1165 cm⁻¹ are ascribed to =C–H stretching vibration from -CH=CH₂ and imidazole ring stretching vibration, respectively. The characteristic peak of the imidazolium group are also observed in the FT-IR spectrum of the ionic liquid polymer functionalized-CNTs (curve 3 in *Fig. S1*), and are shifted to lower wavenumber (1155 cm⁻¹), which may be attributed to the π - π stacking interaction between

* Corresponding author. Tel./Fax: +86-731-88821848

E-mail address: chenjh001@hotmail.com (J.H. Chen)

‡These authors contributed equally to this work.

imidazolium group and CNTs. It should also be noted that the =C–H stretching band of monomer disappeared in the spectrum of CNTs-PIL. These implies that [VEIM]Br were successful polymerized on the surface of CNTs.

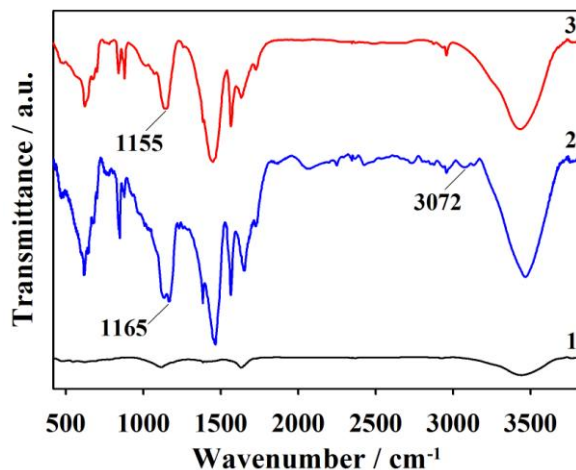


Fig. S1 FT-IR spectra of (1) pristine CNTs, (2) [VEIM]Br, (3) CNTs-PIL.

2. XRD Characterization of Pristine CNTs and SNE-CNTs

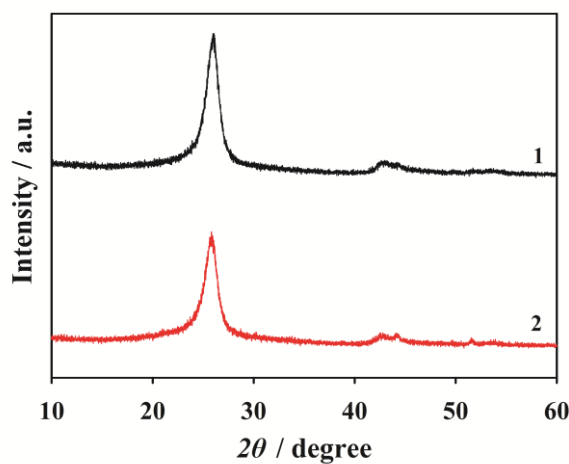


Fig. S2 XRD patterns of (1) pristine CNTs, (2) SNE-CNTs.

The XRD was used to study the structure of the pristine CNTs and SNE-CNTs. The corresponding results are shown in Fig. S2. It is noted that both samples have very similar XRD patterns and exhibit sharp diffraction peaks at $2\theta = 25.8^\circ$, which can be assigned to the graphite

crystallographic planes (002) of CNTs. The results from XRD spectra of the pristine CNTs and SNE-CNTs indicate that the modification process has no detrimental effect on the structure of CNTs.

3. XPS Characterization of SNE-CNTs

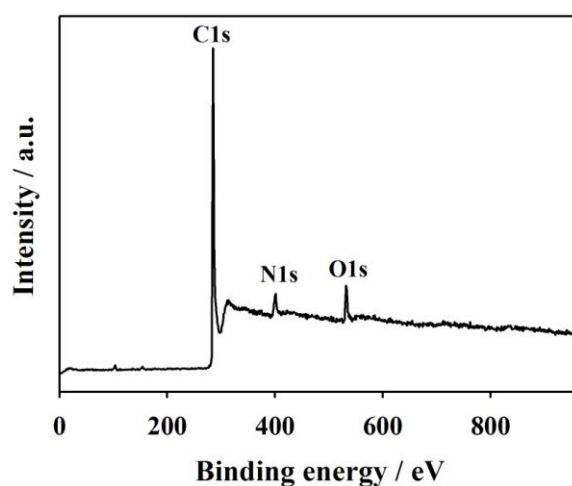


Fig. S3 XPS survey spectrum of the SNE-CNTs.

4. ICP-AES Characterization of PtRu NPs/SNE-CNTs and PtRu NPs/CNTs

The loading mass of PtRu nanoparticles on the PtRu NPs/SNE-CNTs and PtRu NPs/CNTs nanohybrids were determined by Inductively Coupled Plasma-Atom Emission Spectroscopy (ICP-AES) and summarized in Table S1.

Table S1. The results of ICP-AES for PtRu NPs/SNE-CNTs and PtRu NPs/CNTs nanohybrids

nanohybrids	Pt (wt. %)	Ru (wt. %)
PtRu NPs/SNE-CNTs	12.96	5.24
PtRu NPs/CNTs	12.53	4.92