Electronic Supplementary Information (ESI) for

Integrated Pt_2Ni Alloy@Pt Core-Shell Nanoarchitectures with High Electrocatalytic Activity for Oxygen Reduction Reaction

Yuan Zhang, Tingting Han, Jianhui Fang, Pengcheng Xu, Xinxin Li, Jiaqiang Xu,* and Chung-Chiun Liu*

Department of Chemistry, Shanghai University, Shanghai 200444, China

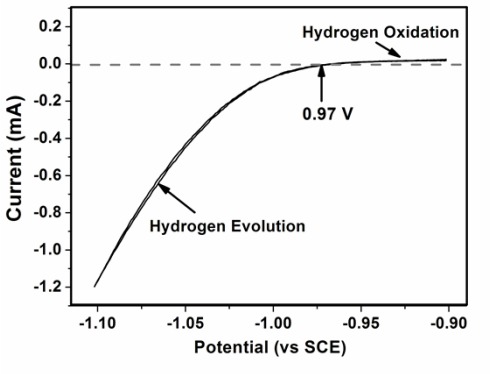
State Key Laboratory of Transducer Technology, Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, Shanghai 200050, China

Department of Chemical Engineering, Case Western Reserve University, Cleveland, Ohio 44106, USA

Supplementary Materials

Reversible hydrogen electrode (RHE) calibration

All the potentials in this work are given versus reversible hydrogen electrode (RHE). The RHE calibration was conducted in the hydrogen (H_2) saturated 0.1 M KOH solution with a Pt wire as the working electrode. Cyclic voltammetry was run at a scan rate of 1 mV s^{-1}, and the average of the potentials at which the current crossed zero was taken to be the thermodynamic potential for the hydrogen electrode reactions.



In 0.1 M KOH, E (RHE) = E (SCE)+0.97 V.

Koutecky-Levich equation and calculation

The kinetic parameters can be analyzed on the basis of the Koutecky-Levich equations [Equation (1)-(3)]:[1]

$$\frac{1}{J}=\frac{1}{J_L}+\frac{1}{J_K}=\frac{1}{B\omega^{1/2}}+\frac{1}{J_K} \quad (1)$$

$$B=0.62nFC_0(D_0)^{3/2}\nu^{-1/6} \quad (2)$$

$$J_K=nFkC_0 \quad (3)$$

where J is the measured current density, J_K and J_L are the kinetic- and diffusion-limiting current densities, ω is the angular velocity ($\omega=2\pi N$, N is the linear rotation speed), n is transferred electron number, F is the Faraday constant (F=96485 C mol^{-1}), C_0 is the bulk concentration of O_2, D_0 is the diffusion coefficient of the electrolyte, ν is the kinematic viscosity of the electrolyte, and k is the electron-transfer rate constant. According to Equations (1) and (2), the number of electrons transferred (n) and J_K can be obtained from the slope of the Koutecky-Levich plots. In 0.1 M KOH solution, the value of above mentioned constants is 1.2×10^{-6} mol cm^{-3} (C_0), 1.9×10^{-5} cm^2 s^{-1} (D_0), and 0.01 cm^2 s^{-1} (ν), respectively.

For the Tafel plot, the kinetic current (J_K) was calculated from the mass-transport correction of RDE by Equation (4):[2]

$$J_K=\frac{J\times J_L}{J_L-J} \quad (4)$$

Reference

1 (a) U. A. Paulus, A. Wokaun, G. G. Scherer, T. J. Schmidt, V. Stamenkovic, V. Radmilovic, N. M. Markovic and P. N. Ross, *J. Phys. Chem. B,* 2002, **106**, 4181; (b) Y. J. Feng and N. Alonso-Vante, *Electrochim. Acta.,* 2012, **72**, 129.

2 (a) Y. J. Li, Z. W. Wang, C. Y. Chiu, L. Y. Ruan, W. B. Yang, Y. Yang, R. E. Palmer and Y. Huang, *Nanoscale,* 2012, **4**, 845; (b) Y. Y. Liang, Y. G. Li, H. L. Wang, J. G. Zhou, J. Wang, T. Regier and H. J. Dai, *Nat. Mater.,* 2011, **10**, 780.