Reduction of Dissolved Oxygen on Glassy Carbon RDE Loaded with MWCNT and MWCNT-Pt

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The carbon nanotubes (CNTs) with unique microstructures and properties have attracted much attention from a great variety of fields. It is natural to test it as catalysts for fuel cell applications. The prominent catalytic activity of MWCNT past electrode for O_2 reduction reaction (ORR) in acidic and neutral solutions has been reported [1]. However there have not been works found to report ORR at rotating disk electrodes (RDE) loaded with CNT. We here report our study on the ORR in acidic solutions at glassy carbon DRE modified with adsorbed multi-wall carbon nano tubes (MWCNT) without and with Pt (10 wt%) (denoted as GC/MWCNT and GC/MWCNT-Pt). The level of loading of MWCNT is ca. 25μg cm^{-2}.

Fig.1 and 2 show linear scanning votammograms for O_2 reduction on GC, GC/MWCNT and GC/MWCNT-Pt at different rotating rates. Fig. 2 shows the plots of I^{-1} vs. $\omega^{-1/2}$ for O_2 reduction on GC/MWCNT at different potentials. The apparent rate constants for O_2 reduction on three types of electrodes calculated from Levich-Koutecky curves are listed in Table 1, in which the data in literatures are also given for comparison. The results show that the onset potentials for ORR on GC/MWCNT and GC/MWCNT-Pt shift positively ca. 200mV and 950mV respectively, compared with that on GC DRE. The electron numbers for ORR are near 2 implying a two-electron reduction mechanism. The apparent rate constant for ORR at MWCNT-Pt is slightly larger than that on MWCNT, 3 orders of magnitude higher than that for GC and close to that for TiO_2 supported nano Pt and Pt (110) electrodes. Above mentioned results indicate that the MWCNT show catalytic activity close to that of nano Pt particles for ORR in acidic solution.

Reference:

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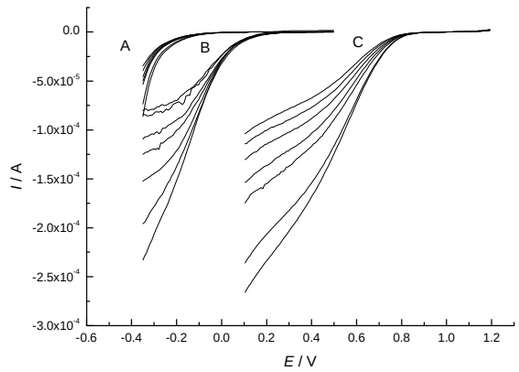

Fig. 1 The linear potential scan polarograms of ORR on GC (A), GC/MWCNT (B) and GC/MWCNT-Pt (C) in 0.5M H_2SO_4. (Rotating rates from the upper to the lower: 200, 300, 400, 600, 800, 2000, 3000 rpm).

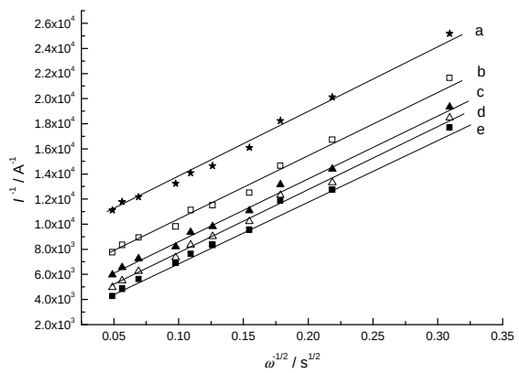

Fig. 2 The plot of I^{-1} vs. $\omega^{-1/2}$ for ORR in 0.05M H_2SO_4 on GC/MWCNT at –0.1v, –0.15V, –0.2V, –0.25V, –0.3V and –0.35V (from a to e).

Table 1 the kinetic parameters for ORR at different electrodes

Electrode	n	K/$cms^{-1}/10^{-2}$	Solution
GC	0.75-2	0.68-3.98x10^{-5}	0.05MH_2SO_4
GC/MWCNT	2.5-2.7	0.6-4.5 (2)	0.05MH_2SO_4
GC/MWCNT-Pt	2-2.9	1.8-3.6 (3)	0.05MH_2SO_4
Nano-Pt/TiO_2[3]		2.9-3.9	0.1MHCl_4
Pt(110)[2]		2.5	0.05MH_2SO_4 and 0.1MHCl_4
Nano-Pt/(Cu)/Au[4]		5.21	0.1M $HClO_4$