Synthesis of Pt on carbon nanotubes by intermittent microwave heating technique*

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DMFCs(direct methanol fuel cells) are attracting much more attention as the potential alternative energy power sources for transport and various portable devices [1]. Pt/C catalyst is widely employed as cathode catalyst for the reduction of oxygen. High Pt loading electrocatalysts of ⩾ 40wt.%Pt with high dispersion and uniformity are often used to decrease the resistance of proton diffusion and reactant gas permeability in the depth of the electrocatalyst layer [2].

Impregnation and colloidal are the most popular methods for preparing Pt/C catalysts. Impregnation method is relatively simple and easier, but the average size of Pt is bigger and the size distribution is broad. In the colloidal method, there are two main routes, that is, sulfite-complex [4] and NR^{4+}–stabilized metal colloids routes [5,6]. The particle size and uniformity can be controlled, however, this method is time-consuming and its procedure is very complex. In the past years, a few new methods were proposed, including ionic exchange [7] and modified alcohol methods [8,9], but, the synthesis of highly uniform and dispersed carbon supported Pt catalysts still remains challenge.

Recently, we proposed a rapid synthesis method based on intermittent microwave heating (IMH) program for rapid preparing Pt/C catalysts [10]. Pt particles less than 5nm uniformly supported on Vulcan-72 carbon with Pt loading up to 50% were one-step prepared by IMH process. The detailed procedure for preparing catalyst has been reported elsewhere [10].

This paper focused on the study of 40%Pt on multi–wall carbon nanotubes (MWCNTs) and on Vulcan-72 carbon black prepared by IMH programs and their performance as the cathode catalyst in DMFC. The characterization of IMH catalysts was conducted by TEM, XRD techniques. TEM images (Fig.1) showed that metal Pt particles were uniformly dispersed on MWCNTs (1a) and VulcanXC-72 (1b). The Pt particles size was ranging from 2.5 to 4.5. The electrochemical activity were measured in the single DMFC. I-E results showed that catalytic activity of Pt on MWCNTS and VulcanXc-72 prepared by IMH process were better than that of E-TEK catalyst and the best performance was observed on the Pt on MWCNTs catalysts.

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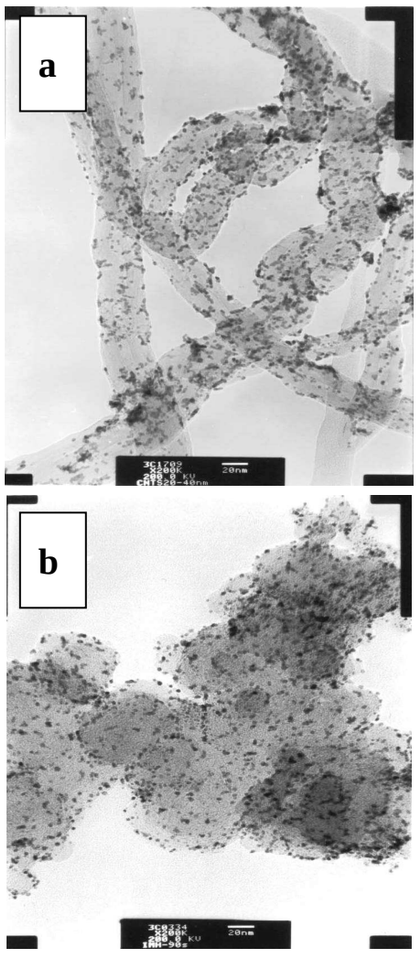

Fig.1 TEM pictures of Pt/C catalysts by prepared by IMH process: (a) 40% Pt/ MWCNTs, (b) 40%Pt / Vulcan-72 carbon black.
Scale bar: 20nm.

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