Supplementary Information for ***Acta Phys. -Chim. Sin.*** **2013**, *29* (6): 1297-1304
doi: 10.3866/PKU.WHXB201304011

Pt 纳米颗粒在氮掺杂空心碳微球上的高分散负载及其氧还原性能

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Well-Dispersed Platinum Nanoparticles Supported on Nitrogen-Doped Hollow Carbon Microspheres for Oxygen-Reduction Reaction

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1 Preparation of HCMS and Pt/HCMS

Taking glucose as the carbon source, HCMS were prepared by the carbonization and etching processes after the pretreatment of SiO_2 particles according to the literature[1]. The procedure for the preparation of HCMS and Pt/HCMS catalyst is the same as that for the preparation of N-HCMS and Pt/N-HCMS catalyst. The loading mass of Pt NPs in Pt/HCMS catalyst was about 10.08% (mass fraction). All electrochemical experiments were performed under the same conditions as described for the Pt/N-HCMS modified GC electrode.

2 Structural characterization of HCMS and Pt/HCMS

A **B**

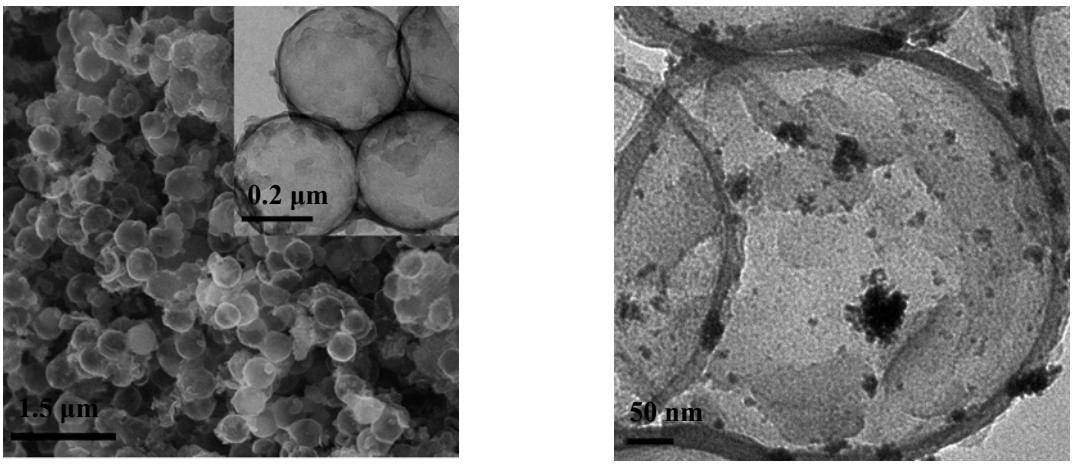

Fig.S1 SEM and TEM images of HCMS (A) and Pt/HCMS (B)
The inset is the TEM image of HCMS

From Fig.S1A, the hollow feature of the microspheres with uniform diameter and shell thickness can be clearly observed. From the corresponding TEM image of HCMS (inset image in Fig.S1A), the average diameter and the shell thickness of HCMS is about 371 and 11 nm, respectively.

3 Electrocatalytic properties of the Pt/HCMS catalyst for ORR

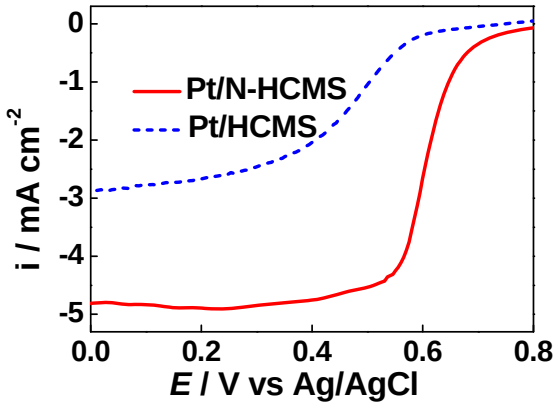

Fig.S2 RDE tests toward ORR on the Pt/N-HCMS and Pt/HCMS catalysts at 1600 $r \cdot min^{-1}$ in O_2 saturated 0.5 $mol \cdot L^{-1}$ H_2SO_4 with a scan rate of 10 $mV \cdot s^{-1}$

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From Fig.S2, the onset and half-wave potential of ORR on the Pt/HCMS catalyst are about 0.624 and 0.468V, respectively, and negatively shift about 112 and 137 mV in comparison with those on the Pt/N-HCMS catalyst.

4.1 Durability of the Pt/HCMS catalyst for ORR

A B

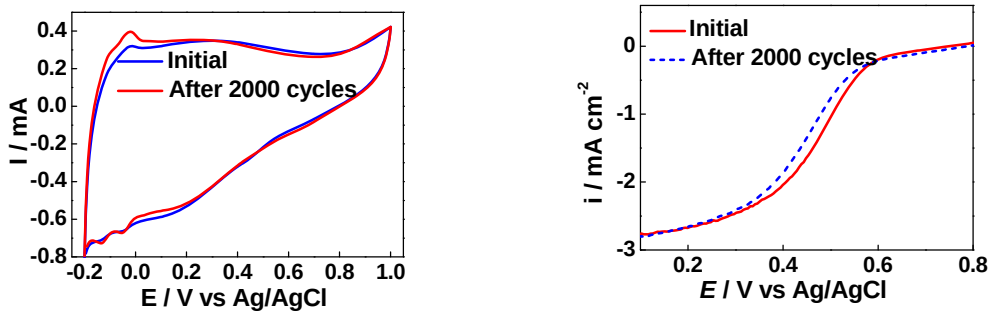

Fig.S3 (A) CV and RDE (B) tests of the Pt/HCMS catalyst before and after ADT

The long term electrochemical stability of the Pt/HCMS catalyst was also evaluated by ADT under the same condition. Before and after ADT, the ESA evaluation and the related RDE tests of the Pt/HCMS catalyst were carried out and the corresponding results are shown in Fig.S3. From Fig.S3, it is noted that the ESA value and the decrease of the half-wave potential of the Pt/HCMS catalyst are about 24.2 $m^2 \cdot g^{-1}$ and

32.5 mV, respectively. On the other hand, the ESA value of the Pt/HCMS catalyst decreases about 23% after 2000 CV cycles (Fig.S3A).

Reference

(1) Ikeda, S.; Tachi, K.; Ng, Y. H.; Ikoma, Y.; Sakata, T.; Mori, H.; Harada, T.; Matsumura, M. *Chem. Mater.* **2007,** *19* (17), 4335.