Pt and PtRu nanoparticles supported on ordered mesoporous carbons as electrocatalysts for Direct Methanol Fuel Cell anodes

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Direct Methanol Fuel Cells (DMFCs), which use liquid and renewable methanol fuel, are attracting much attention for portable applications, because liquid methanol has got a high energy density, and it can be easily stored and transported. In addition, it avoids the use of a reforming unit in the fuel cell system and simplifies the balance of plant.

On the other hand, the success of these fuel cells systems requires a further development of new DMFC anode catalysts with high performance and low cost. The most effective way to approach this task is to explore new catalyst materials (noble and non-noble metals) and supports (carbon nanomaterials, metal oxides,…), because supported electrocatalysts can lower the noble metal loading in fuel cell electrodes [1].

Methanol electrooxidation takes place over the surface of the metal nanoparticles located in the active layer of the DMFC anode, which is also responsible for the transport of reactants a and reaction products. Conventional carbon blacks usually used as a catalyst support lead to a low degree of catalyst utilization due to the relative abundance of micropores (< 2 nm), so that the catalyst particles deposited inside them remain inaccesible to the fuel. In this sense, the use of mesoporous ordered carbons (OMC) with controlled pore size in the range of 2-50 nm, can enhance the utilization and dispersion of metal catalyst.

In this presentation we report the electrocatalytic activity of Pt and PtRu nanoparticles supported on ordered mesoporous carbons towards methanol electrooxidation in a DMFC environment. OMC used as catalyst support were synthetized via mesoporous silica SBA-15 as templating material and had a specific area of 570 m^2 g^{-1}. Their hexagonally ordered structure was maintained after oxidation treatments in liquid phase using nitric acid as oxidizing agent [2]. OMC were used as platinum and platinum/ruthenium catalyst support using the method of reduction with $NaBH_4$ or HCOOH acid [3].

The results reported in this poster illustrate that DMFC anodes made with Pt nanoparticles supported on ordered mesoporous carbons show a good performance towards methanol electrooxidation. This behavior is enhanced using PtRu nanoparticles as anode catalyst.

Acknowledgments

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References:

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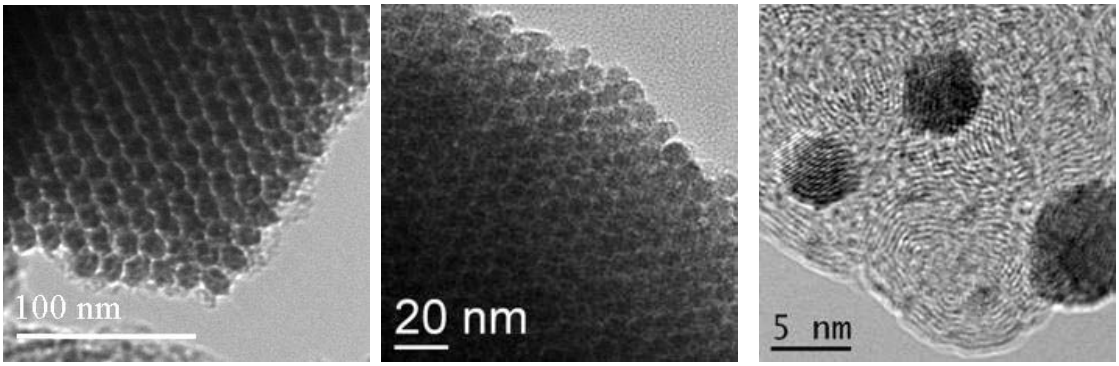
Figures:



(a) **(b)** **(c)**

Fig. 1. TEM micrographs: (a) CMK-3 carbon, (b) CMK-3 carbon treated with HNO_3 (from ref. 1 and ref. 2, respectively), and (c) PtRu supported nanoparticles.

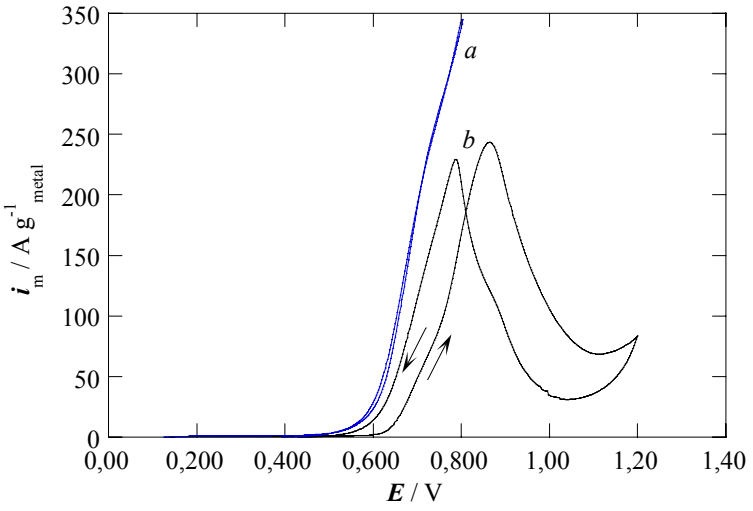


Fig. 2. Cyclic voltammograms of methanol oxidation on DMFC anodes catalyzed by: (a) PtRu/CMK3-Nc0.5 and (b) Pt/CMK3-Nd0.5, in 2.0 M CH_3OH + 0.50 M H_2SO_4. T = 60°C. v_b = 20 mV s^{-1}.

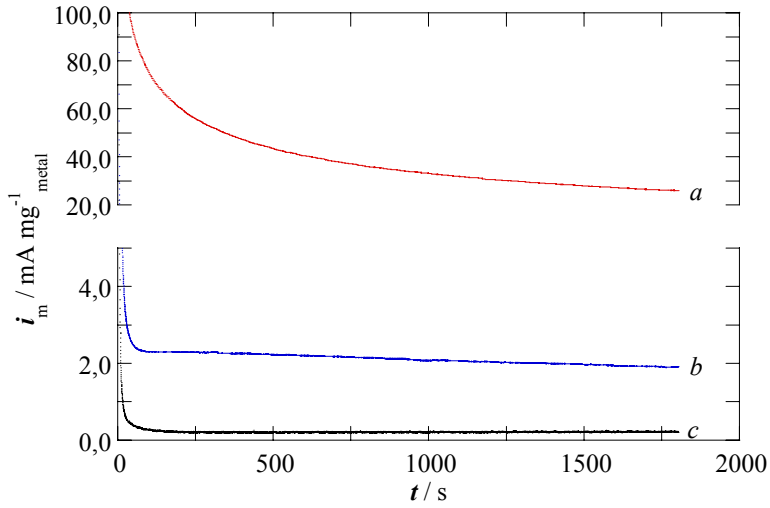


Fig. 3. Chronoamperometric curves of methanol oxidation on DMFC anodes catalyzed by: (a) PtRu/CMK3-Nc0.5, (b) Pt/CMK3-Nd0.5, and (c) Pt/CMK3-Nc2h in 2.0 M CH_3OH + 0.50 M H_2SO_4. T = 60°C. v_b = 20 mV s^{-1}.