Synthesis, characterization, and durability study of Pt-Co hollow nanoparticles deposited on carbon xerogel electrocatalysts for Proton Exchange Membrane Fuel Cells (PEMFC)

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Proton exchange membrane fuel cell (PEMFC) catalysts are generally made of carbon black (CB)-supported platinum-based nanoparticles. However, the properties of CBs, as described by Rodríguez-Reinoso [1], are not optimal for electrocatalysis. A possible solution to the drawbacks of CBs is the use of synthetic nanostructured materials with a controllable and reproducible texture and with a pure, known and constant chemical composition; carbon xerogels (CX) exhibit such properties [2].

Recently, various highly dispersed CX-supported Pt nanoparticles catalysts (Pt/CX) have been synthesized *via* several methods, such as the strong electrostatic adsorption (SEA) [3] or the charge-enhanced dry impregnation (CEDI) [4].

However, the decrease of the Pt mass contained in the PEMFC electrodes, in particular at the cathode where the oxygen reduction reaction (ORR) is processed, remains a major challenge. Improving the ORR mass activity is currently best achieved by alloying Pt with 3d-transition metal atoms such as cobalt (Co). These alloys perform better than the ORR because the substitution of some Pt atoms by 3d-metal atoms with smaller radius leads to a modified Pt electronic structure [5]. The synthesis and durability of Pt-Co hollow particles/CX (Fig. 1) is currently being studied in our groups. The results indicate that the specific and mass activity of the bimetallic hollow particles dispersed on CX is *ca.* 10 times higher than that of pure Pt/CB. The first durability results show good stability of the hollow particles structure. Performances and accelerated stress tests (ASTs) in PEMFCs were finally performed.

References

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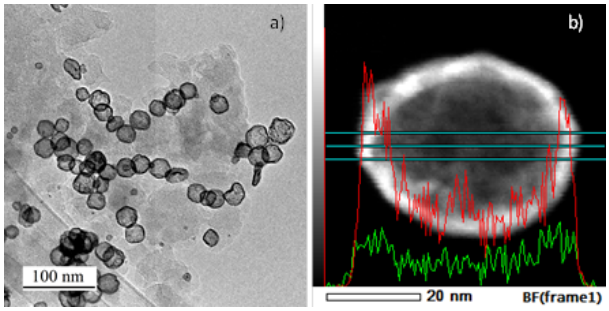

a) TEM micrograph of Pt-Co hollow particles/CX, and b) EDX line-scan of a single hollow particle, the profiles show Pt (red profile) and Co (green profile) over the entire particle. The obtained image corresponds to the projection of a hollow shell as indicated by the lack of signal in the center.

Keyword(s)

Carbon xerogel-hollow nanoparticles-platinum-cobalt-electrochemistry-fuel cell