Modified carbon xerogels as electrocatalyst supports for PEMFCs

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Proton Exchange Membrane Fuel Cells (PEMFCs) are devices able to generate electricity through a simple electrochemical reaction between dihydrogen and dioxygen, with numerous applications, mainly in the transportation sector. One of the major challenges in their deployment is to improve their lifetime. To achieve this, many studies focus on the electrodes, *i.e.* the catalytic layers, usually made of a carbon material onto which platinum or Pt-M (M being a transition metal) nanoparticles are supported[1].

Commercially, carbon black is the most used catalyst support, however carbon corrosion causes the platinum particles to detach and/or agglomerate, resulting in a decrease of the ElectroChemically active Surface Area (ECSA). To overcome this problem and improve the catalyst stability, previous studies focused on carbons with the most crystalline structure possible[2]. However, crystalline surfaces usually lead to more mobile Pt particles, resulting also in agglomeration and loss of ECSA, thus making it necessary to better anchor the metal particles onto the support.

The main goal of this work was therefore to improve the stability and durability of the carbon material used in PEMFCs. To achieve this, carbon xerogels[3] were synthesized and used as main support. Their advantage is their tuneable pore texture from small mesopores to large macropores, enabling to manage mass transport within the electrode[4]; however as disordered carbons, they are prone to oxidation upon cell operation. To tackle that issue, a more crystalline layer of carbon was firstly deposited on their surface using the Chemical Vapor Deposition (CVD) method[5]. Secondly, functionalization processes were applied to these carbons (CVD-coated or not) using nitrogen-rich compounds to improve the anchoring of metal particles[6], that were deposited subsequently onto the carbon surface. To correlate the carbon properties with the catalyst stability, physicochemical properties and electrochemical performances were studied before and after ageing using Accelerated Stress Tests (ASTs) on Rotating Disk Electrode configuration. In a further step, electrochemical characterization and ASTs will be performed in complete Membrane-Electrodes Assemblies with the most promising catalysts.

References

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