

### Covalently, Non-Covalently and Non Functionalized Networked Graphitic Structures as robust catalyst support in PEM electrodes

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Networked Carbon Graphitic structures, here called Carbon Nano Networks (CNNs), result a robust catalyst support in PEM fuel cells electrodes. This special class of nanostructures, Figure 1, is synthesized by Chemical Vapor Deposition of ethylene on various metallic catalyst nanoparticles, e.g Ni, Pt, Co [1]. The networked carbon structure is obtained from the graphitization of the large amount of ligand stabilizing nanoparticles, that can be produced at exceptionally high yield [2,3]. CNNs show remarkably high thermal stability, thermal and electric conductivity and mechanical strength.

Platinum nanoparticles are attached to covalently, non covalently and non functionalized CNNs [4,5]. The obtained catalyst activity and electrochemically active surface area (ECSA) are tested by rotating disk electrode. ECSA decrease is tested by accelerated durability tests, cycling the potential between 0.6 and 1.2 V vs RHE. Oxidation resistance is tested by thermogravimetric analysis.

Pt/CNNs result more active and more durable than commercial catalyst, Figure 2. CNNs have higher oxidation resistance than other carbon supports, resulting in catalyst higher durability under fuel cell operating conditions. Additionally, a networked structure allow for an even electrical conductivity thus reducing potential gradients in the electrode responsible of Ostwald ripening. Platinum deposited over non-covalently functionalized CNNs result the most durable catalyst, due to the even distribution of monodisperse nanoparticles, efficiently bound to the graphitic surface via  $\pi$ - $\pi$  interaction with pyrene carboxylic acid, Figure 3.

The relatively low cost of the synthesis procedure and their good performance make CNNs a potential substitute of actual catalyst support for Fuel Cell applications.

### REFERENCES

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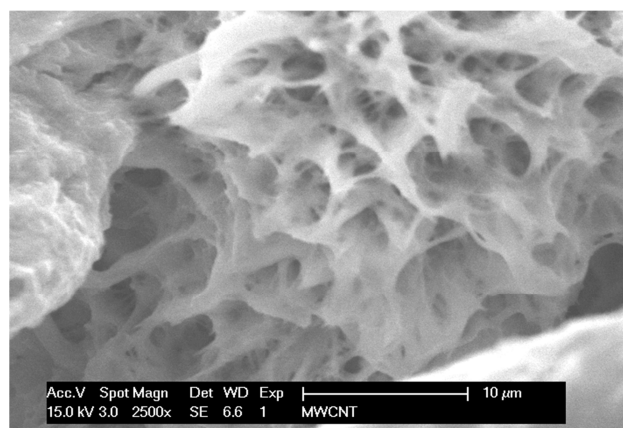


Figure 1 SEM image of Carbon-Nano-Networks

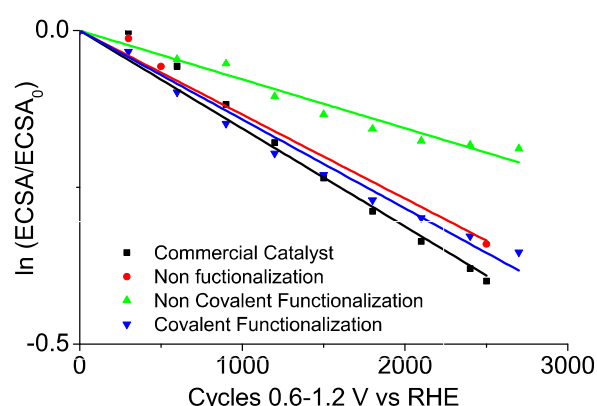


Figure 2 Accelerated durability tests

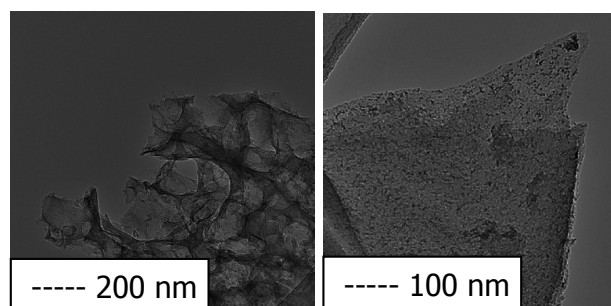


Figure 3 Platinum nanoparticles over non-covalently functionalized CNNs