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## Mapping the electrocatalytic activity of N-doped Carbon Nanotubes by Scanning ElectroChemical Microscopy for oxygen reduction.

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In this project, we use Scanning ElectroChemical Microscopy (SECM) <sup>[1]</sup> to investigate the electrocatalytic activity of individual carbon nanotubes toward the oxygen reduction reaction (ORR) in acidic media as for Proton Exchange Membrane Fuel Cell (PEMFC). Our approach consists in displacing a nano-electrode in the vicinity of the nano-objects in order to acquire an image of their electrocatalytic activity.

To reach this goal, we first set up the fabrication of nano-electrodes. In order to detect the concentration in O<sub>2</sub>, we choose to work with gold probes, and to achieve a high spatial resolution we decreased the size of the probe up to about 100 nm. The probes are then characterized by imaging a model substrate with motifs of different sizes (see figure), and are further used to image sample where functionalized NTC are dispersed. <sup>[2]</sup>

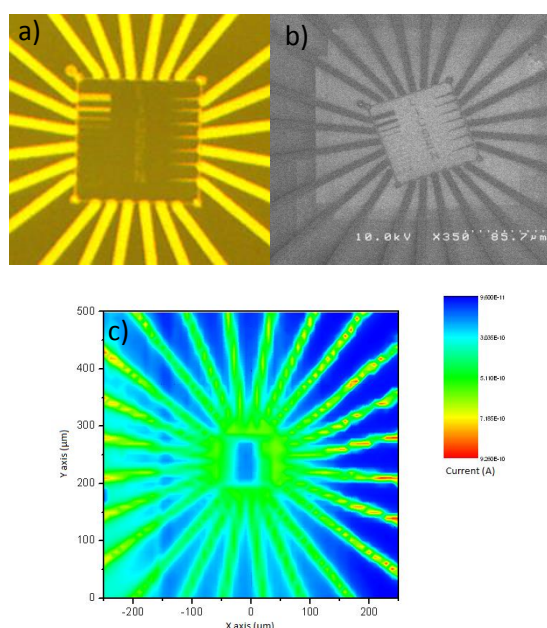


Fig. 1: a) Optical microscopy image b) SEM image c) SECM image (done with 10  $\mu$ m diameter gold electrode in FcMeOH 1mM and KCl 0.1M) of the model substrate used to characterize the probes.

This methodology will permit to understand the origin of the achieved performances without any distortion due to the averaging of the response when working at the material level. We thus hope to understand the ORR mechanism with N-NTC and improve the state of the art methodologies for the synthesis of noble metal free electrocatalyst. This will contribute to make PEMFC more competitive.

[1] O'Connell, M. A.; Wain, A. *J. Anal. Methods*, **2015**, 7, 6983– 6999.

[2] I. Hijazi, T. Bourgeteau; R. Cornut; A. Morozan; A. Filoramo; J. Leroy; V. Derycke; B. Jousselme; and S. Campidelli. *J. Am. Chem. Soc.*, **2014**, 136 (17), 6348–6354.