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Mapping the electrocatalytic activity of modified Carbon Nanotubes by Scanning ElectroChemical Microscopy for Oxygen Reduction.

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The massive adoption of Proton Exchange Membrane Fuel Cell (PEMFC) technology is critically depending on the finding of new materials to substitute noble metals for Oxygen Reduction Reaction (ORR).

In this field, performances are usually evaluated with Rotating disk electrodes (RDE). Unfortunately in this configuration the signature of the electrocatalytic activity is convoluted with different contributions such as the porosity, the electronic conductivity, the roughness, etc. In this project we propose to use Scanning ElectroChemical Microscopy (SECM)^[1] to investigate the electrocatalytic activity of modified carbon nanotubes (NTC)^[2].

Our approach consists in the study of individual and small aggregates of these nano-objects in order to acquire an image of their electrocatalytic activity. For this we acquire concordant SECM and SEM images of NTC agglomerates as illustrated in figure 1. This methodology permits to identify the origin of the achieved performances without distortion due to the averaging of the response when working at the material level. This permits to better understand the ORR mechanisms and improve the state of the art methodologies for the synthesis of noble metal free electrocatalysts.

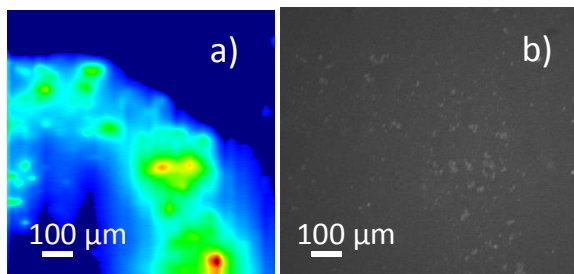


Fig. 1: a) SECM image (done with 0.3 μm diameter gold electrode in H_2SO_4 0.5M) of the ORR activity of NTCs b) SEM image of the same area.

[1] D. Polcari, P. Dauphin-Ducharme and J. Mauzeroll. *Chem. Rev.*, **2016**, 116, 13234–13278.

[2] P. D. Tran, A. Morozan, S. Archambault, J. Heidkamp, P. Chenevier, H. Dau, M. Fontecave, A. Martinent, B. Jusselme and V. Artero. *Chem. Sci.*, **2015**, 6, 2050–2053.