



**HAL**  
open science

## Doped tin dioxide aerogel as alternative catalyst support for Proton Exchange Membrane Fuel Cells

Guillaume Ozouf, Christian Beauger

### ► To cite this version:

Guillaume Ozouf, Christian Beauger. Doped tin dioxide aerogel as alternative catalyst support for Proton Exchange Membrane Fuel Cells. 3rd International Seminar on Aerogels 2016: “Properties-Manufacture-Applications”, Sep 2016, Sophia Antipolis, France. hal-01426999

**HAL Id: hal-01426999**

**<https://minesparis-psl.hal.science/hal-01426999>**

Submitted on 5 Jan 2017

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Doped tin dioxide aerogels as alternative catalyst supports for Proton Exchange Membrane Fuel Cells

Guillaume Ozouf, Christian Beauger\*

MINES ParisTech, PSL Research University PERSEE - Centre procédés, énergies renouvelables et systèmes énergétiques, CS 10207 rue Claude Daunesse  
06904 Sophia-Antipolis Cedex, France

\*corresponding author

guillaume.ozouf@mines-paristech.fr

Catalyst supports for Polymer Electrolyte Fuel Cells (PEFC) are currently made up of carbon blacks. This material is however not thermodynamically stable in fuel cell operating conditions and loss of performance is observed with time, especially at the cathode side. To improve PEFC durability and make this technology a credible alternative to conventional power sources, carbon free cathodes were prepared. With a remarkable morphology, aerogels have already proven their ability to efficiently support catalysts for PEMFC application [1, 2]. In this study doped tin dioxide aerogels are proposed as alternative supports presumably stable in PEMFC operating conditions.

Antimony, niobium or tantalum doped tin dioxide aerogels were synthesized using sol-gel route in acidic media from alkoxide precursors. These materials have shown particularly adapted physico-chemical properties [3]. Platinum was deposited on doped SnO<sub>2</sub> aerogels following two methods. Method A was based on the impregnation of a platinum salt further reduced in a reducing atmosphere or under UV irradiation. The influence of a post heat treatment was studied. Method EG is a conventional polyol method using ethylene glycol. Electrocatalysts structures and morphologies were investigated by X-ray diffraction and transmission electron spectroscopy. Active Electrochemical Surface Areas (ECSA) and catalytic activities for oxygen reduction reaction (ORR) were measured on Rotating Disk Electrode (RDE). Heat treatments have shown direct influence on Pt structure and crystallinity. Highest ECSA was recorded after method A (45 m<sup>2</sup>. mg<sub>Pt</sub><sup>-1</sup>) while highest ORR mass activity was measured after method EG (40 mA. mg<sub>Pt</sub><sup>-1</sup>). This value is even higher

than that of the chosen carbon based electrocatalyst reference, TEC10E40E, measured in the same conditions ( $23.4 \text{ mA} \cdot \text{mg}_{\text{Pt}}^{-1}$ ).

The work presented here is funded by the European Union's Seventh Framework Program for the Fuel Cells and Hydrogen Joint Technology Initiative under grant agreement n325239 (FCH-JU project Nano-CAT) and the French National Research Agency PROGELEC programme, (ANR-12-PRGE-007 project SURICAT). It was supported by Capenergies and Tenerrdis.

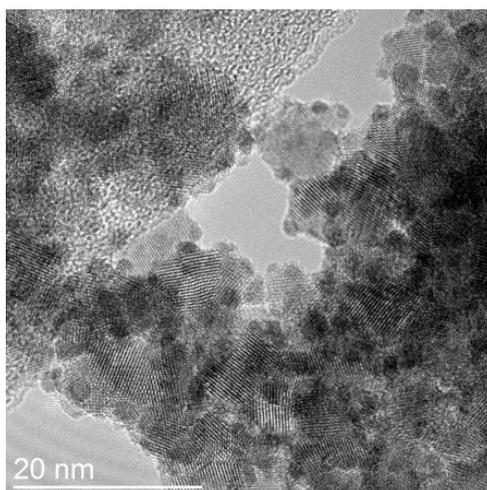


Figure 1. TEM image of a Pt/Sb-doped  $\text{SnO}_2$  aerogel obtained from method A

## REFERENCES

1. M. Ouattara-Brigaudet, , S. Berthon-Fabry, C. Beauger, M. Chatenet, N. Job, M. Sennour, Influence of the carbon texture of platinum/carbon aerogel electrocatalysts on their behavior in a proton exchange membrane fuel cell cathode. *International Journal of Hydrogen Energy* 37, 9742-9757 (2012).
2. M. Ouattara-Brigaudet, C. Beauger, S. Berthon-Fabry, P. Achard, Carbon Aerogels as Catalyst Supports and First Insights on Their Durability in Proton Exchange Membrane Fuel Cells. *Fuel Cells* 11, 726-734 (2011).
3. G. Ozouf, C. beauger, Niobium- and antimony-doped tin dioxide aerogels as new catalyst supports for PEM fuel cells, *Journal of Materials Science* DOI 10.1007/s10853-016-9833-7 (2016)