Fuel cells realisation by printing processes

1rst year

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Printing Processes

The thesis topic is part of the CATIMINHY project (Couches Actives développées par des Technologies d'ImpressIoN Hybrides, Catalyst Layer Developed by Hybrid Printing Processes), financed by the ANR (Agence Nationale de la Recherche). This project aims to realize MEA (Membrane Electrode Assembly) components with printing processes for their integration in PEMFC (Proton Exchange Membrane Fuel Cells).
MEA are composed by five different layers:
- A gas diffusion layer, also called backing, in which reactive gases are conducted to the active layer,
- An active layer, or catalyst layer, in which electrochemical reactions and electronic conduction take place,
- An electrolytic membrane, composed by Nafion polymer, which allows protons transport to a second active layer,
- The second active layer,
- A gas diffusion layer.

Printing processes offer a continuous manufacturing and low consuming method to produce MEA. In this work, indirect printing processes are pointed out, such as gravure and flexography. Layers printing can be performed by two methods:
- Catalyst Coated Membrane, where active layer ink is transferred onto the electrolyte membrane,
- Catalyst Coated Backing, where active layer ink is printed onto the gas diffusion layer.

In order to obtain the best performances, both printing methods are being tested and compared.
The key points are:

- The optimization of the interface between the substrates and the deposited layer,
- The characterization of the catalyst layer,
- The optimization of material consumption by thinning down the catalyst layer,
- The deposition of the different layers by printing processes,
- The control of pore and material concentration gradients,
- The control and the repeatability of the transfer operations.