Graphene and Related Materials or how to choose the best way to process such material in PEMFC ?

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Carbon blacks supported Pt, currently widely used as electrocatalysts in Polymer Electrolyte Membrane Fuel Cells (PEMFC) are thermochemically unstable in PEMFC operating conditions. This is especially true at the cathode side where, on top of relatively elevated temperature (80°C) and acidic conditions, both the potential and the relative humidity may be high. The resulting carbon oxidation is partially responsible for the PEMFC performance decrease observed over time. Hence, long term durability still needs to be improved in order to consider PEMFC as credible alternatives to conventional power sources for automotive, stationary or portable applications.

Much effort have been directed to identify and synthesize alternative carbon materials as catalyst supports for PEMFCs. One strategy to decrease carbon support corrosion is to use carbon with high extent of graphitization, which is supposed to decrease defect sites on the carbon structure, where carbon oxidation starts [1], [2]. However high graphitic content of carbon can be a brake for particle nucleation and dispersion. Among the different forms of carbon, graphene have attracted tremendous interest over many conventional catalyst support materials for various energy applications.

In this work, platinum catalysts were synthetized on Graphene support by UCL and Imperial partner [3] of CORE2 project, nanocharacterised, processed in ink and incorporated in fuel cell at CEA. Several techniques of MEA fabrication were used: CCB (catalyst coated backing), CCM (catalyst coated membrane) or CCM by decal (transfert on inert substrate). We investigated these new active layers at the cathode side in term of electrocatalytic performance and compared the electrochemical properties of these hybrid materials with a commercial Pt/C catalyst using carbon blacks as carbon support. Moreover, the use of additive was also studied to enhance performance by aerate active layer and avoid pi-stacking of graphene layer.

The goal of the project is to demonstrate that the use of GRM based carbon supports can be promising in effectively reducing the carbon corrosion and then increase lifetime of the cell. Accelerated stress test will be done in fuel cell setup and compared with a commercial Pt/C catalyst using carbon blacks as carbon support.

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References

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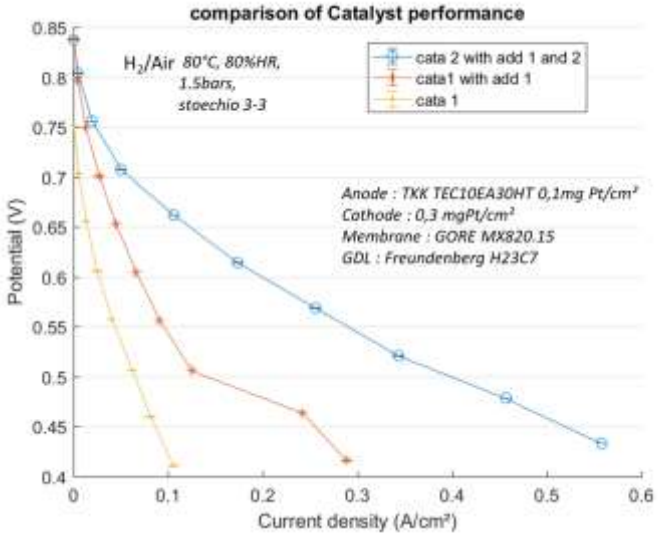

Figure 1: Polarization curve of graphene catalyst at cathode side in H2/Air: impact of additive on electrochemical performance