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**Cr/C multilayers coating for proton exchange membrane fuel cells bipolar plate**

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The bipolar plates of Proton Exchange Membrane Fuel Cells (PEMFC) are key components of the cell; instead of using graphite, for weight and cost consideration, research is currently made in order to replace graphite by coated stainless steel. This coating must resist to drastic conditions in terms of corrosion, but also has to ensure a good conductivity and a low interfacial contact resistance (ICR), and present a reasonable price. These target values are fixed by the Department of Energy (DOE) but, in the industrial production process, the coating must also tolerate a high deformation if the plate is stamped for designing its channels after the coating deposition.

Among the promising processes, PVD deposition of coatings such as CrN, CrNC, TiN, and CrC are in agreement with the target values (below  $10\text{m}\Omega\cdot\text{cm}^2$  for ICR and  $1\mu\text{A}\cdot\text{cm}^{-2}$  for corrosion), but the deformation tolerance of these coatings are limited. In our work, we investigate the synthesis and the characterization of new coating layers. In particular, the synthesis of a Cr/C multilayer coating on stainless steel sheet by magnetron sputtering is currently under study and shows many promising results. The process, monitored by plasma emission spectroscopy (PEM) offers an accurate control of the coating characteristics (layer composition, layer thickness, interfaces). The number of layers, and the carbon and chromium content in each unit layer have a strong influence on the key properties (ICR, corrosion and deformation) that have been investigated through a set of experiments. Assemblies of 4, 10, 20 and 40 layers with different chromium and carbon content (from 30 to 70%), but a similar total thickness ( $\approx 800\text{nm}$ ) have been studied and exhibit corrosion current below  $0.1\mu\text{A}\cdot\text{cm}^{-2}$ , a deformability up to several % and ICR values in the range from 40 to  $100\text{m}\Omega\cdot\text{cm}^2$ . SEM cross-section and XPS depth profiling characterization have been performed before and after ICR and corrosion tests to link the coating characteristics and its electrochemical behaviour.

**Keywords**

PEMFC

multilayer coating