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Optimisation of Electrophoretic Deposition Parameters for GDEs in High Temperature PEMFCs

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Abstract: Electrophoretic deposition (EPD) method was used to fabricate Gas Diffusion Electrodes (GDE) for High Temperature Polymer Electrolyte Membrane Fuel Cells (HT PEMFC). Parameters related to the catalyst suspension and the EPD process was studied. Optimum suspension conditions are obtained when the catalyst particles are coated with Nafion® ionomer and the pH is adjusted to an alkaline range of about 8 to 10. These suspensions yield good stability with sufficient conductivity to form highly porous catalyst layers on top of the Gas Diffusion Layers (GDLs). GDEs were fabricated by applying various electric field strengths of which 100 V cm^{-1} yields the best Membrane Electrode Assembly (MEA) performance. Compared to an MEA fabricated by the traditional Hand Sprayed (HS) method, the EPD MEA shows superior performance with a peak power increase of about 73% at similar platinum (Pt) loadings. Electrochemical Impedance Spectroscopy (EIS) analysis shows lower charge transfer resistance for the MEA fabricated *via* the EPD method compared to the HS MEA. The EPD GDE exhibits a greater total pore area (22.46 $m^2 g^{-1}$) compared to the HS GDE (13.43 $m^2 g^{-1}$) as well as better dispersion of the Pt particles within the catalyst layer (CL).