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# Closed Field Unbalanced Magnetron Sputter Ion Plating of high performance coatings on PEMFC metallic bipolar plates

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Metallic bipolar plates (BPPs) for PEMFCs have many advantages due to their high strength, formability, mechanical durability & electrical conductivity. As thin metallic foils, they save weight and space. Even stainless steel, however, requires a protective, electrically conductive coating to inhibit corrosion, ensure continued electrical functionality and adequate longevity in the aggressive electrochemical environment of the fuel cell. Maximising system efficiency requires coatings that minimise electrical impedance, decreasing parasitic losses. Power density [kW/kg] is enhanced as the mass of the coated plates is minimised. Coatings also play a role in the management of water within the cell, however the requirements are complex: hydrophilicity of the coated plate may offer advantages at start up, under low RH conditions, whereas when a stack is operating at high power and approaching 100% RH, a hydrophobic surface may assist in the clearance of the water from the cells. Closed field unbalanced magnetron sputter ion plating (CFUBMSIP) produces dense, well adhered coatings. Transition metal nitrides and graded, nano-composite, non-hydrogenated amorphous carbon, provide the combination of properties required in this application. The quality and integrity of these engineering coatings allows thickness to be minimised while achieving functionality and longevity, minimising production costs. We describe the progress towards the industrial production of CFUBMSIP coatings for the metallic BPPs, using high rate reactive magnetron sputtering for transition metal nitrides (in particular, CrN) and carbon-based coatings (from elemental metal and solid graphitic magnetron sputtering targets). The characterisation of the coatings, in terms of their properties, relevant to the PEMFC application is described, and future developments are discussed.

**Keywords**
Magnetron
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