The Challenges in Developing the Cathode For Automotive PEM Fuel Cells

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The commercialization of automotive PEM fuel cells has been long awaited. One of the major impediments to market entry has been the cost of the technology compared to the entrenched, existing internal combustion technology. The cost of the fuel cell stack is directly impacted by the performance and durability of the individual components, especially the cathode catalyst layer, which contains the majority of the precious metals and which faces the most extreme operational conditions during its lifetime in a vehicle.

Traditional catalyst layers are composed of platinum nanoparticles supported on a high surface area carbon in a layer deposited as an ink containing ionomer that acts as a binder as well as an electrolyte and transport medium for both reactants and products. The challenges that face the catalyst layer developer are two-fold: firstly, there are fundamental performance and durability issues with the catalyst materials themselves (Pt and carbon support) and, secondly, the design control parameters that define the catalyst layer structure are limited, being based upon the ink composition and the coating process used.

Recently, advances have been made in catalyst morphology and catalyst layer structure that have started a drive towards a more optimized design of the catalyst layer. Characterization tools are being developed to feed information into models to deliver multiscale design tools for the catalyst layers in the next generation of fuel cell stacks [1-3].

[1] Moore, M; Putz, A and Secanell, M; J. Electrochem. Soc. 160 (2013) F670-F681

[2] Susac, D; Berejnov, V; Hitchcock, A.P and Stumper, J; ECS Trans. 50(2) (2012) 405-413

[3] Berejnov, V; Susac, D; Stumper, J and Hitchcock, A.P; ECS Trans. 50(2) (2012) 361-368