**ABSTRACT**

The oxygen reduction reaction (ORR) for low temperature fuel cell applications limits its performance due to sluggish kinetics. A new attempt to improve the ORR reaction kinetics were investigated through fabrication of multilayered PtFeCo alloys, by means of pulse potential deposition, to create catalysts with a nano-layered structure. The distinct nano-scaled layers had a Pt-rich or FeCo-rich composition. Prior to making multilayer catalysts, thin films were deposited under constant potential. Data obtained from from thin film electrodeposits facilitated the identification of elemental composition and thickness at the applied potentials of interest.

Potentiostatic deposition of the ternary alloys occurred at more positive potentials than the equilibrium potentials of Fe and Co, assuming unit solid state activity, commonly referred to as under potential (UPD) or “induced” co-deposition. Partial current densities of Co in the overpotential deposition (OPD) region increased with increasing potentials following a first order reaction rate. Likewise, both UPD and OPD regions exhibited higher Co-current densities with the addition of Co (II) content in the electrolyte. The inverse Tafel slopes for Fe and Co during alloy deposition with Pt, between potentials of -0.6 to -0.9 V vs. Ag/AgCl, were 18.8 and 18.6 V⁻¹, respectively. Guided by the thin film results, mutlilayers were deposited at -300 and -800 mV vs. Ag/AgCl resulting in a Pt-rich and FeCo-rich alloy, stacked in a sandwich fashion. The deposition current efficiencies were the highest at these stated potentials.

In unsteady-state cyclic voltammetry analysis multilayered catalysts exhibited higher current response toward ORR in comparison to Pt-rich thin films. On the other hand, the ORR of FeCo-rich thin film appeared as active as some of the multilayers. The exchange current densities of the multilayers in steady-state cyclic voltammetry experiments were larger than the Pt-rich thin films.
The morphology was examined using a Zeiss optical microscope. The results suggested surface roughness was not influential on oxygen reduction activity with compositional and layering variations. However, a further morphological evaluation is recommended using scanning electron microscopy (SEM), and cross sectional layering confirmation can be confirmed by transmission electron microscopy (TEM).