

## Thermally Stabilized Nickel Electro-Catalyst by Infiltration for High Temperature Electrochemical Energy Conversion

Stephen W. Sofie, David Driscoll  
Montana State University

### Abstract

Nickel based metal catalysts yield important performance benchmarks in electrochemical energy conversion and electrolysis at temperatures that exceed 600°C. While very fine metal catalysts can be achieved by solution precursor infiltration, rapid coarsening of high surface area particulate readily degrades both catalytic activity and electrical conduction. The stabilization of metallic electro-catalysts into the sub-micron and nano-regime for use at high temperatures provides an important opportunity to extend the performance potential of non-noble metals for commercial viability. This study focuses on establishing a new method of anchoring metal catalysts at high temperatures by engineering chemical reactions at the interface. The application of the chemical additive aluminum titanate (ALT) as a means of chemically binding nickel catalyst particles to a stabilized zirconia support was investigated to identify extension to other catalyst/support systems including cerium oxide. The decomposition behavior of ALT and formation of chemical reactions with nickel/zirconia components was evaluated with a detailed XRD diffraction study from 1000 – 1400°C. XRD indicated that the  $\text{NiAl}_2\text{O}_4$  half anchor formed at temperatures as low as 1100°C and the  $\text{ZrTiO}_4$  half anchor formed around 1200°C which was dependent on the precursors used. Transmission electron microscopy was employed to investigate the morphology by which the ALT induced chemical anchors to bind the nickel metal to the support, in which two discrete configurations of chemical anchors were observed. Further, electrical conductivity and electrochemical testing of anchored nickel catalysts in electrochemical cells utilizing solution infiltrated precursors will be reported.