

## **Performance and Stability of High temperature Solid-oxide Electrolyzers**

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Ceramatec, in collaboration with Idaho National Laboratory under the DOE Nuclear Hydrogen Initiative has been evaluating SOEC cells and stacks using SOFC materials set developed at Ceramatec. The cells and stacks showed good reversibility between the two modes, and the performance scaled as expected from short stacks to tall stacks. However, a significant difference in long-term stability was observed. The SOEC mode of operation suffered significantly higher performance degradation.

Some potential causes for degradation are common to SOFC device operation while others are unique to SOEC mode of operation. The dominant degradation mechanism that appear unique to SOEC operation was related to interface delamination of the oxygen evolution electrode. Oxidation of metallic components in high temperature and high steam conditions in SOEC mode is particularly severe near the seal areas. Other causes that may be common to both modes are: deposition of species at electrochemical sites to cause electrode poisoning and phase instability of current distribution layer. Under a project funded by the Office of Naval Research, systematic evaluation of various materials was undertaken to address the stability issues. Some of the changes evaluated include the use of Sc-stabilized zirconia electrolyte, new electrode materials, protective coatings on interconnects, and alternative seal options. These materials changes are found to improve stack stability significantly.