

## **502c Durability Analyses of a Silicon Carbide Based Decomposer for the Si Process**

*Merrill A. Wilson*

The Sulfur-Iodide (SI) process has been investigated extensively as an alternate process to generate hydrogen through the thermo-chemical decomposition of water. The commercial viability of this process hinges on the durability and efficiency of heat exchangers/decomposers that operate at high temperatures under corrosive environments. In cooperation with the DOE and the University of Nevada, Las Vegas (UNLV), silicon carbide (SiC) based micro-channel decomposer concepts are being developed and tested. The performance benefits of a high temperature, micro-channel heat exchanger are realized from the thermal efficiency due to improved effectiveness of micro-channel heat and mass transfer and the corrosion resistance of the ceramic materials. Although the overall design and validation of a ceramic decomposer includes corrosion testing, thermal-hydraulics modeling, mechanical stress modeling and empirical validation testing, this paper focuses on the thermo-mechanical design issues. In designing these devices, the mechanical stresses due to temperature and pressure conditions must be minimized to compensate for the brittle nature of the ceramic materials. Finite element models were used to predict the local and global thermo-mechanical stresses of these heat exchangers. Analog strength samples were tested to estimate the failure strength of the materials of construction. These results, finite element stresses and statistical strength data were coupled with weibull statistical models to predict the life and durability of the heat exchanger. It was found that through geometric optimization the thermo-mechanical stresses could be minimized yielding a feasible design that satisfies the performance and reliability objectives required for commercial implementation.