FRACTURE SIMULATION OF SOLID OXIDE FUEL CELLS (SOFCS)

P. Zhang[a] and **R. Solasi**[b]

[a]Department of Mechanical Engineering
University of Connecticut
Storrs, Connecticut 06269
pzhang@engr.uconn.edu

[b] Department of Mechanical Engineering
University of Connecticut
Storrs, Connecticut 06269

Fuel cell technology has been identified as one of the key areas for next-generation sustainable energy sources. Of the many types of fuel cells, solid oxide fuel cells (SOFC) have been energetically pursued in the past several decades. However, research activities are generally devoted to optimizing electrochemical, thermal and micro-structural properties of different materials, even though the mechanical properties of SOFC components are also of essential importance to the functionality of fuel cells.

Yttria-stabilized cubic zirconia (YSZ) has been widely used as solid electrolyte in high temperature SOFCs. A layer of YSZ/Al2O3 is usually sintered onto the YSZ electrolyte to be used as electrodes. The bonding strength has a significant effect on the development of cracks in SOFCs. In this project, a cohesive model is adopted to study the fracture process in a high-temperature SOFC. Numerical results provide insights to the mechanism of different fracture patterns found in SOFCs manufactured under different sintering temperatures.

References

[1] A. Atkinson, and A. Selcuk, "Residual stress and fracture of laminated ceramic membranes", *Acta Materialia*, v. 47, p. 867-874, 1999.
[2] A. Selcuk, and A. Atkinson, "Elastic properties of ceramic oxides used in solid oxide fuel cells (SOFC)", *Journal of the European Ceramic Society*, v. 17, p. 1523-1532, 1997.
[3] A. Selcuk, G. Merere, and A. Atkinson, "The influence of electrodes on the strength of planar zirconia solid oxide fuel cells", *Journal of Materials Science*, v. 36, p. 1173-1182, 2001.
[4] B.F. Sorensen, and A.N. Kumar, "Fracture resistance of 8 mol% yttria stabilized zirconia", Bulletin of Materials Science, v. 24, p. 111-116, 2001.
[5] B.F. Sorensen, and S. Primdahl, "Relationship between strength and failure mode of ceramic multiplayer", Journal of Materials Science, v. 33, p. 5291-9300, 1998.
[6] X.P. Xu, and A. Needleman, "Numerical simulations of fast crack growth in brittle solids", Journal of the Mechanics and Physics of Solids, v. 42, p. 1397-1434, 1994.