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# Failure of Solid Oxide Fuel Cells by Electrochemically Generated Internal Pressure

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Solid oxide fuel cells, solid oxide electrolyzers, lithium-ion batteries, and other electrochemical devices degrade under various operating conditions. This paper will discuss fundamental mechanism of failure by electrochemically generated internal pressures, whose origin lies in coupled transport of ions, such as oxygen ions, and electrons. It is shown theoretically and experimentally that large pressures (several hundred MPa) are generated under modest applied voltages (fractions of a volt) and currents (mA). The reason for high pressure is its exponential dependence of voltage. Cracking under such large pressures cannot be mitigated by attempts to improve mechanical properties such as toughness or strength since no amount of toughening can be sufficient. Rather, transport properties (ionic and electronic conductivities) must be optimized to prevent high pressure development. This work shows that coupling between electrochemical and mechanical phenomena are responsible for failures. Approaches which increase reliability through optimization of electrochemical transport properties will be presented.

**Keywords:** Internal pressure;Interface delamination;

**Preferred Presentation Type:** lecture