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High-Resolution Thermo-Mechanical Modeling for Enhancing the Long-Term Reliability of Solid Oxide Fuel Cells

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Enhancing the long-term reliability and durability of solid oxide fuel cells (SOFCs) is crucial for meeting the high-performance standards required in modern applications. Achieving this goal necessitates high-resolution modelling that accurately captures the critical phenomena affecting cell operation. The long-term performance of SOFCs can be significantly impacted by degradation processes arising from intense stress fields induced by high operating temperatures, oxide growth on interconnect structures and creep deformation. This study introduces a finite element thermo-mechanical model of a planar SOFC, analyzing both co-flow and cross-flow configurations. The influence of operating temperature distribution on mechanical stresses and the structural integrity of solid interconnects is examined, and a predictive model for the evaluation of oxide growth is proposed. This research contributes to advancing SOFC design and operational stability, thereby enhancing their long-term viability in energy applications.

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