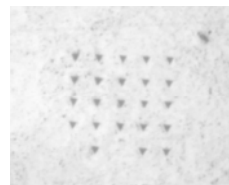
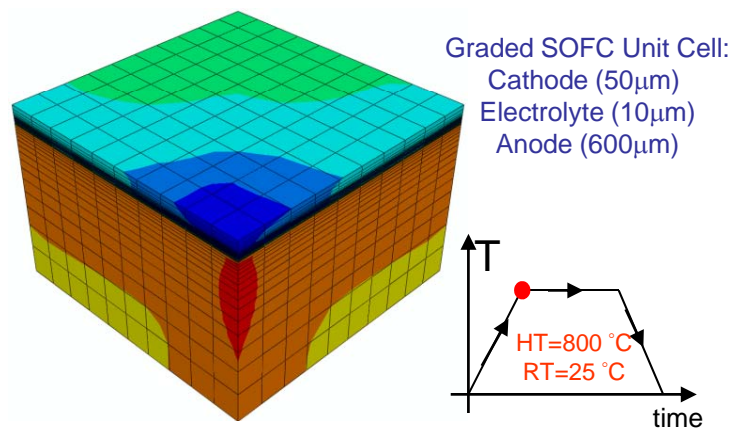
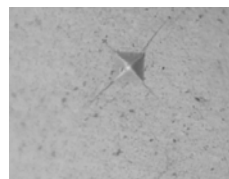


Functionally Graded SOFCs

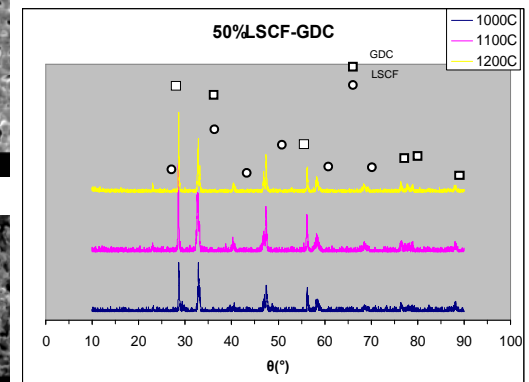
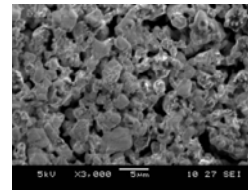
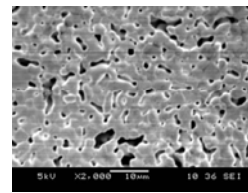
- **Research Goals:** To enhance the performance and the mechanical durability of a solid oxide fuel cell (SOFC) by using functionally graded electrodes, and to develop robust 3D finite element analysis & damage models.
- **Approach:** Perform 3D finite element analysis for SOFC under transient thermal cycling, and Manufacture & test SOFC with graded LSCF-GDC cathodes.
- **Results To Date:** Verified an in-house 3D FEM code for transient thermal analysis for FG continua. Measured thermo-mechanical and electrochemical properties for fuel cell components, and have been performing cell testing.



Nano-indentation



Micro-indentation

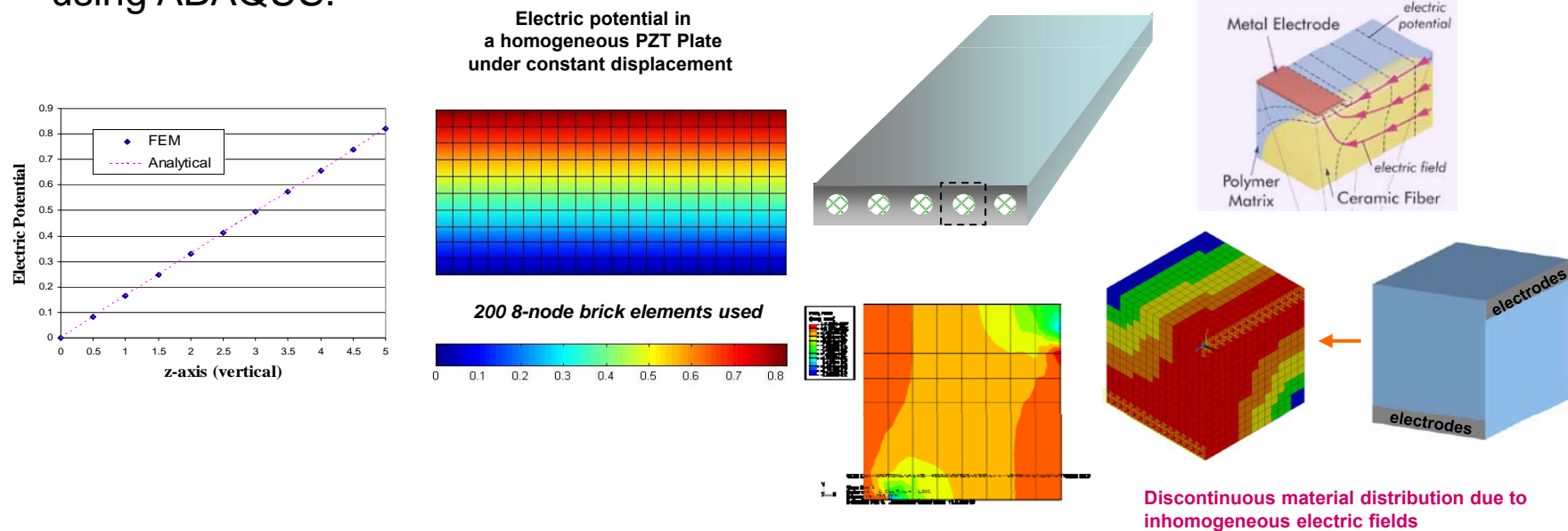


SEM picture, XRD pattern 50% LSCF-GDC cathode at various temp.

- **Future Plans:** Validate the developed model with graded SOFC under thermal cycling.
Validate the advantages of graded SOFC over conventional SOFC

Modeling of Multifunctional Composite Sensors

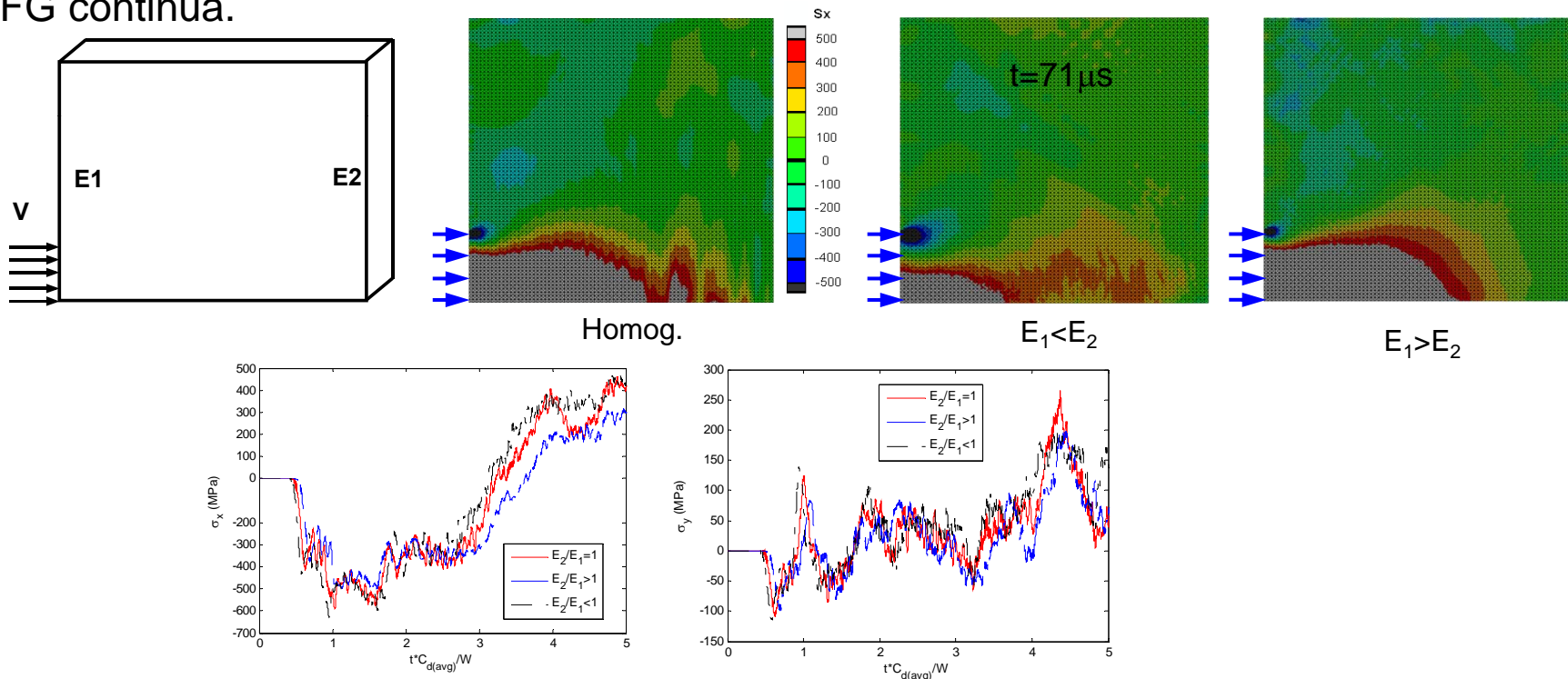
- **Research Goals:** Provide design guideline for improving performance of impact resistant multi-functional composite sensors
- **Approach:** Develop generalized graded finite elements and perform coupled thermo-mechanical-piezoelectric 3D finite element analysis
- **Results To Date:** Developed an in-house 3D FEM code, and performed 3D analysis using ABAQUS.



- **Future Plans:** Perform parametric study using various design configurations to be provided and validate with experiments

Impact Behavior of Functionally Graded Solids

- **Research Goals:** Understand dynamic characteristics of functionally graded (FG) solids under dynamic impact. Develop robust three-dimensional finite element analysis tools.
- **Approach:** Perform 3D finite element analysis for FG solids under transient mechanical loads.
- **Results To Date:** Verified an in-house 3D FEM code for transient mechanical analysis for FG continua.



- **Future Plans:** Simulate non-linear stress-strain behavior
Model dynamic fracture and fragmentation