Goals and Technical Approach

**Keys to Reducing Cost of SOFCs**
- Lower operating temperatures (inexpensive interconnects)
- Increased power densities (efficient materials utilization)
- Low-cost raw materials
- Increased manufacturing yields
- Efficient materials utilization (advanced stack designs)

**Why Focus on Cathodes?**
- Critical path to lower operating temperatures
- Critical path to increasing power densities
- Anode-supported cell designs offer flexibility for utilizing new cathode materials

**Target Cathode Characteristics:**
**Performance Attributes**
- High electrical conductivity
- Gas permeability (porosity)
- Oxygen mobility (ionic conductivity)
- Catalysis of oxygen reduction reaction

**Chemical/Structural Properties**
- Thermal expansion match to electrolyte
- Compatibility with electrolyte material
- Long-term stability (>40,000 hours)

**Alternative Cathode Synthesis Studies**
- Strategy: Increase Oxygen Vacancies in LSF
  - A-site Doping Effective (Anderson, Steele, Kharton, Kostoglou et al.)
  - Doping of B-site with Co very effective (Sridevi, Anderson)
  - Higher Risk/Reward
  - Lack of rapid screening methods
  - Longer evaluation/validation/acceptance timeframes

**Baseline Compositions:**
- (La0.60Sr0.40)FeO3-
- (La0.60Sr0.40)(Co0.20Fe0.80)O3-
- (La0.60Sr0.40)(Cu0.20Fe0.80)O3-
- (La0.60Sr0.40)(Ni0.20Fe0.80)O3-
- (La0.60Sr0.40)(Zn0.20Fe0.80)O3-

**Electrochemical Performance of Cathode Materials**

**SOFC Performance of Cathode Materials**

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**Image Descriptions:**
- XRD Patterns
- Coefficient of Thermal Expansion (RT-1000°C)
- Electrical Conductivity (Four Point Electrodes)
- Interfacial Resistance Measured by Direct Current Measurements on Symmetric Electrode/GDC/Electrode Samples
- Interfacial Resistance Measured by Impedance Spectroscopy on Symmetric Electrode/GDC/Electrode Samples
- Fuel Cell Performance for Thin Film GDC Electrolyte SOFC Cells with LSF (left) and LSNF (10% Ni) Cathodes (right)