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Low-temperature plastic deformation of a perovskite ceramic material

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Abstract

Anomalous plastic deformation properties at ambient temperature were demonstrated for lanthanum strontium manganite (LSM). Bar samples fabricated from a range of compositions exhibited plastic deformation under ambient conditions when subjected to bending stresses of 40 MPa or less. The transition from the plastic deformation properties of LSM to the rigid properties of ceria was demonstrated via a series of composite materials. Plastic deformation of LSM increased with increasing strontium on the A-site. The plastic deformation properties of LSM displayed a striking dependence on processing history, and in particular on cooling rate. The data suggested a thermally activated process with a penetration depth associated with the capacity for deformation. Structural changes associated with the nonstoichiometry of lanthanum strontium manganites may be induced by the uptake of oxygen during cooling. However, the phenomena leading to the ambient temperature plastic deformation in LSM are complex, and further evaluation of this novel behavior is required before a comprehensive understanding of the mechanism is reached.

Keywords: Lanthanum manganite; Lanthanum strontium manganite; Perovskite; Oxygen nonstoichiometry; Plastic deformation; Creep; Mechanical properties; SOFC

Article Outline

1. Introduction
 2. Experimental
 - 2.1. Powder processing and characterization
 - 2.2. Sample preparation
 - 2.3. Deformation testing and laser profilometry
 3. Results and discussion
 - 3.1. Plastic deformation of LSM and LSM/ceria composites
 - 3.2. Composition dependence
 - 3.3. Processing dependence
 - 3.4. Penetration depth
 - 3.5. Annealing experiments
 - 3.6. Thermogravimetric experiments
 - 3.7. General discussion
 4. Conclusion
- Acknowledgements
- References