CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
S0216

Project Title
Mechanical Properties of Cesium Hydrogen Sulfate for Fuel Cell Applications

Abstract

Objectives/Goals
Cesium hydrogen sulfate (CHS) is a solid acid that has been demonstrated as a promising fuel cell electrolyte; however, its poor mechanical strength may undermine fuel cell stability. The mechanical properties of CHS were investigated to characterize plastic deformation, and thus to guide the development of improved composites.

Methods/Materials
Creep deformation was studied under 0.3 MPa-1.0 MPa stress at a temperature range of 120-160 ºC. Three data verification procedures were taken to strengthen results. A homemade ball mill and a thermomechanical analyzer were utilized.

Results
At temperatures above the superprotonic phase transition (SPT), creep activation energy is 200±10 kJ/mol and appears to be limited by cesium ion diffusion. Stress exponents at different temperatures were determined and changed from n ~ 1 to n ~ 2 upon SPT, confirming that the deformation has dependency on SPT. Unique behaviors were also characterized.

Conclusions/Discussion
A complete understanding of these properties resulted in the engineering and identification of a silica nanocomposite material with superior mechanical properties.

Summary Statement
Logical scientific methodology was utilized to engineer a material with superior mechanical properties.

Help Received
Used lab equipment at the California Institute of Technology under the tutelage of Mikhail Kistlitsyn