Link for Thermal Expansion Movie: <http://dl.dropbox.com/u/4874361/HfO2_Heating_TestSet_2010-12-21.avi>

You should be able to just click on that link and download the movie. It’s 255mb. If not I will bring it by tomorrow morning.

Description for CTE Movie:

The CTEAS can be used to create visual representations of HTXRD data such as a movie of thermal expansion over a range of temperatures. An example of this can be seen in the included movie of the thermal expansion of Hafnium Oxide. It can also create figures of planar expansion, plots of eigenvalues, lattice parameters, and expansion along a user-specified crystallographic direction. CTEAS provides a way to understand the thermal expansion of a crystal not only in the three principal axis directions as traditionally reported, but in any crystallographic direction the user chooses. These expansion data can also be exported to spreadsheet-compatible files, enabling the user to have further control over the analysis. This fundamental knowledge of expansion behavior can lead to design of new materials with desirable high temperature thermal expansion properties.

Highlight Points: CTEAS

Objective

* Develop a fast, user-friendly program for analysis of HTXRD data to determine more comprehensive knowledge of the thermal expansion of a crystalline material.

Approach

* National Instruments LabVIEW was used to create a graphical user interface (GUI) for an extensive set of functions written in MATLAB. The power of the LabVIEW GUI combines with the speed and utility of the MATLAB command line to form CTEAS.
* Use Reitveld analysis to determine the locations and spacings between atoms on a crystalline lattice. A set of input files can be generated for CTEAS from this analysis. CTEAS is built to handle user-created input files as well as the “.rrp” extension from MDI JADE.
* From these input files, CTEAS fits a curve to lattice parameters over the range of temperatures the data were taken. A set of thermal expansion coefficients for user-specified temperature steps is determined from the lattice parameter fits.
* Thermal expansion ellipsoids can be generated from the thermal expansioncoefficients. The CTEAS can produce three-dimensional figures and movies of thermal expansion over a range of temperatures.
* CTEAS can also produce plots of the lattice parameters and their curve-fits, eigenvalues of the expansion matrix, thermal expansions along a crystallographic direction and in a plane, and export all of its data to spreadsheet-readable files.
* CTEAS is designed with presentation of data in mind, allowing figures and movies to be generated at a specific pixel size. This eliminates the need to stretch or shrink a figure for use in a presentation.

Intended Impact

* Research aid in comprehensive understanding of the thermal expansion characteristics of new, high temperature materials for use in current and future aerospace needs.
* Quicken analysis time for HTXRD data, allowing for more materials to be characterized.

Broader Impact

* Set a new, higher standard for the amount of information that must be reported about the high temperature thermal expansion characteristics of a material.
* Determine new uses for materials in aerospace based on their complete thermal expansion characteristics