DIRECTIONS OF ZERO THERMAL EXPANSION IN ANISOTROPIC OXIDES

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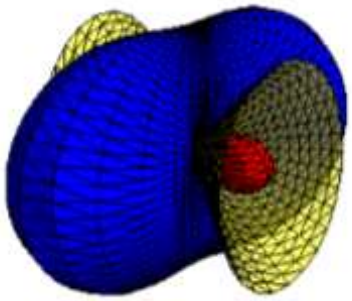

Figure 1. – Quadric surface visualizing the coefficients of thermal expansion of $HfTiO_4$ at room temperature. Blue is positive, red is negative and yellow represents directions of zero thermal expansion.

Oxide materials often have anisotropic crystal structures, which can result in direction-dependent material properties. While they typically have positive coefficients of thermal expansion, it has been observed that some oxide materials can have directions of negative thermal expansion over certain temperature ranges. Such materials, having both positive and negative coefficients of thermal expansion, must also have particular directions in which the thermal expansion is zero. Using the Quadrupole Lamp Furnace (QLF) developed in the Kriven group at the University of Illinois at Urbana Champaign, high-temperature in-situ x-ray diffraction has been performed at the National Synchrotron Light Source II (NSLS II) X-ray powder diffraction beamline (XPD – 28-ID) to track directions of zero thermal expansion in orthorhombic $HfTiO_4$. These results have important implications for the design of composites for high-temperature applications.