In-situ high temperature spatially resolved X-ray diffraction of TiB2 up to ~3250 ˚C

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In-situ high temperature X-ray diffraction experiments were performed on X-ray phase pure TiB2 (reported melting point of 3230 ˚C) up to ~ 3250 ˚C at Argonne National Laboratories, Advanced Photon Source, beam-line 6-ID-D. TiB2 powders were fabricated into spherical beads via gel casting methods and were densified in a high temperature graphite furnace at 2300 ˚C. These spheres were then levitated in a conical nozzle levitator (CNL) using a forming gas (3%H2-Ar) to minimize oxidation, while being heated with a 400 W CO2 laser. The CO2 laser (10.6 µm) and pyrometer (0.9 µm, with an emissivity correction of 0.35) were aligned to the tip of the TiB2 bead. The X-ray beam was focused to a width of 0.5 mm and height of 0.2 mm and was used to scan the bead from the tip down until the beam came into contact with the nozzle. A multi-wavelength spectrometer (0.5 µm to 1 µm) is being integrated into a CNL system at UC Davis that will be used in the future to assist with in-situ high temperature emissivity corrections. The high-temperature, high resolution, spatially resolved X-ray diffraction data was used to calculate the anisotropic thermal expansion of TiB2 from room temperature up to ~3250 ˚C along with thermal strain gradients within the levitating TiB2 bead. These in-situ high temperature measurements will be critical in developing ultra-high temperature material systems for applications in hypersonic vehicles, nuclear fission/fusion reactors, and spacecraft.

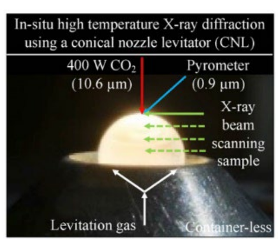

Figure 1