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Deformation of the $CaIrO_3$ Post-Perovskite Phase to 5 GPa and 1300 K in the Multi-Anvil Press

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Abstract: At ambient conditions, $CaIrO_3$ is isostructural with $MgSiO_3$ post-perovskite and thus can serve as an analog for studying the plastic properties of the post-perovskite phase. At present the only way to attain the pressures needed for $MgSiO_3$ post-perovskite is in the diamond anvil cell (DAC). However, current technology for radial diffraction experiments does not allow deformation at high-temperatures in the stability field of $MgSiO_3$ post-perovskite and thus investigation of possible high-temperature slip systems that may affect texturing is not possible. The advantage of the multi-anvil press is that it allows for relatively large volume deformation at simultaneous high-temperature and pressure, while also allowing the user to decouple hydrostatic stress from deviatoric stresses. The disadvantage is that the available pressure range is greatly reduced compared to the DAC. The stability field of $CaIrO_3$ post-perovskite extends to 1800 K at 3 GPa, making it amenable to study with the multi-anvil press. Here we study the plastic behavior of $CaIrO_3$ post-perovskite at a variety of conditions within its stability field. Polycrystalline $CaIrO_3$ post-perovskite was synthesized from a 1:1 molar ratio of CaO and IrO_2 by first heating in a vacuum-sealed silica tube to 980° C at ambient pressure for 68 hours followed by compression to 7 GPa and 1100° C for 4 hours. The sample was deformed in the D-DIA multi-anvil press at pressures of 2-3 GPa and 4-5 GPa and temperatures of 298 K, 600 K, 800 K, 1000 K, and 1300 K. Deformation was accomplished in several compression cycles of up to 20% strain for each temperature and pressure. Each compression cycle was followed by extension to 0% strain. Quantitative texture information is obtained using in-situ synchrotron x- ray diffraction images and the Rietveld method to deconvolute spectra. In all cases we find that the (010) lattice planes align perpendicular to the compression direction, and that there is no change in texture with temperature. This texture is consistent with slip on (010) lattice planes. It appears that in $CaIrO_3$ post-perovskite temperature does not have a significant effect on the activation of slip systems. The texture observed here is different from that produced in room temperature DAC measurements on $MgGeO_3$ post- perovskite and $MgSiO_3$ post-perovskite which both displayed textures of (100) lattice planes nearly perpendicular to the compression direction.