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# Ultrafast X-ray diffraction for measurements of thermal conductivity in $Cr_2AlC$

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## Abstract

**Ultrafast X-ray diffraction (UXRD) was used to measure impulsive laser induced strain dynamics in $Cr_2AlC$ and its c-axis thermal conductivity. The c-axis thermal conductivity is estimated above 2 W/(m·K) and below 15 W/(m·K). This limits the degree of anisotropy that can be expected between in-plane and cross-plane thermal conductivity. Ellipsometry measurements show slight changes in the complex index of refraction with incident angle between 40° and 80°. High temperature ellipsometry measurements show some changes in the extinction coefficient above 600 nm. UXRD results show a dependency of the (002) Bragg peak displacement and its width on the exact incident angle of the X-rays. Dynamical X-ray diffraction simulations show the dependency of measured strain on optical absorption depth, beam width, thermal conductivity, incoming fluence and heat capacity. A shallow optical absorption depth will result in a maximum strain to appear later in comparison to larger depths. The X-ray angular beam width impacts the observed dynamics at relatively narrow width values, shifting the maximum strain and shape of the strain in time due to larger influence from lower angle scattered photons. This highlights the requirement of precise measurement of the X-ray beam angular width. Strain gradient may play a role in speed of the dynamics measured based on simulations with different coefficients of thermal expansion. The dependency of the thermal diffusivity on temperature is also an important factor in the strain observed.**