OPTICAL AND ELECTRONIC PROPERTIES OF LOW-SYMMETRY MATERIALS

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We discuss analysis of the dielectric function tensor for monoclinic metal-oxides. Generalized ellipsometry using an eigenpolarization vector summation approach [1] from the terahertz to the vacuum-ultra-violet spectral regions, and as a function of temperature (Fig. 1) [2], along with optical Hall effect, permit us to unravel all infrared active transverse and longitudinal optical phonon modes [3], free carrier excitations [3], band-to-band transitions [4], optical constants [4], exciton properties [4], effective mass parameters [5] and directional dependencies in single crystalline β-Ga_2O_3. We compare our findings with results from density functional theory calculations [4], and we revise and augment previous incomplete assignments [6,7].

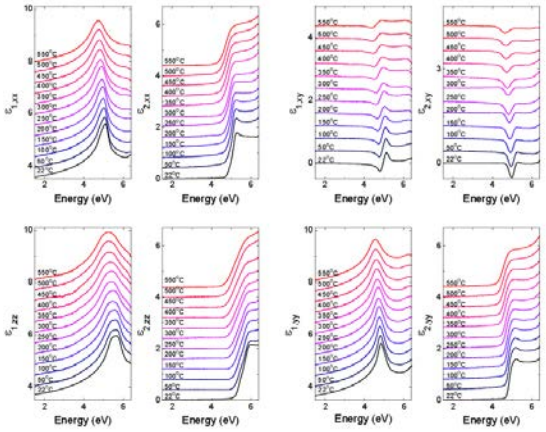

Figure 1: Real and imaginary components of the dielectric tensor elements, ε_{xx}, ε_{yy}, ε_{xy}, and ε_{zz} for room temperature (black) to 550°C (red) determined by generalized ellipsometry. The functions were shifted vertically by increments of 0.4 with respect to each other for convenience. Ref. [2]

We apply this same approach to other monoclinic oxides such as $CdWO_4$ [8] (Fig. 2) and Y_2SiO_5 [9] as well as to triclinic materials.

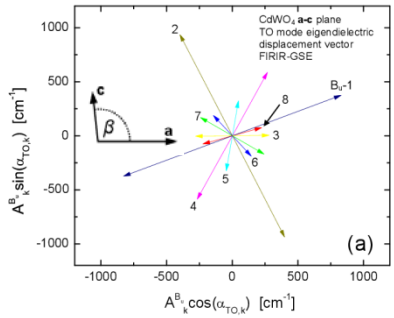

Figure 2: Schematic presentation of the Bu symmetry TO mode eigendielectric displacement unit vectors within the **a-c** plane according to TO mode amplitude parameters $A^{Bu}{}_k$ and orientation angles $\alpha_{TO,k}$ with respect to axis a obtained from generalized ellipsometry analysis. Ref. [8]

Keywords: Low-symmetry, monoclinic, Ga_2O_3

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