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Title:

" Polarized Raman scattering of 2-D structures"

Abstract:

Raman spectroscopy has emerged as a very powerful tool to characterize nano structures and 2-D materials. Polarized Raman spectroscopy adds to the power and provides directional information about the 2-D structures like carbon nano tubes, Graphene and epitaxial thin films. In this lecture the basics of Raman spectroscopy and analysis of the Raman mode using polarized Raman spectroscopy will be described. The power of Polarized Raman spectroscopy in obtaining information about Raman Tensors of epitaxy of thin films and single crystals will be elaborated. Several examples will be given illustrating the effect of dimensionality reduction, strain, and particle size reduction on Raman spectra. The effect of anomalous changes in the lattice parameter of NdGaO3 single crystal substrate as a function of temperature will be shown to be directly reflected in the phonon structure. The epitaxial nature of CuO thin films is deduced using polarized Raman scattering. The effect of magnetic order on the phonon structure in this system will be discussed. The local domain structure of a strain free, 150 nm thick, epitaxially grown single crystalline thin film of CaCu3Ti4O12 is probed by polarized Raman spectroscopy. The polarization dependence of the Raman intensities of the observed bands as a function of varying angle between the domain axes and the polarization vector of the scattered laser photon is measured. Theoretical formulations involving the Raman tensor are presented, which enable determination of the domain structure from the observed polarized Raman spectra, and a single-crystal-like domain structure is found. The Raman tensor elements and domain orientation direction were determined by fitting the observed Raman intensities with theoretical calculations and by carrying out Raman mapping of the film. Our data show an absence of twin domain structure and twin domain boundaries in the single-crystal-like epitaxial thin films of CaCu3Ti4O12.