Determination of Interface Compositions by X-ray Three-beam Resonance Diffraction

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X-ray three-beam diffraction (200/31) under resonant conditions is used to measure the concentrations of the constituent elements of the interface between a (100) CdTe thin film and a (100) InSb substrate. The intensity modification with \( \psi \) scan along the primary reflection \( G(=200) \) is related to triplet-phase \( \delta_{\pm} \), and +, - is standard for \((O, G, L)\) and \((O, -G, -L)\) case, respectively. The L reflection is the so-called secondary reflection, which is the \((31)\) or \((3 \bar{1} \bar{1})\).

Through the adjusted parameters, the triple-phases for + and – cases can be obtained as the following equation.
\[
\tan \delta_{\pm} = \left( b_{\pm} - b_{\mp} \right) / 2a_{\pm}c_{\pm}
\]

It is shown the triplet phases change drastically with energies going through the absorption edges, Cd L II and CdLIII. Similarly the triplet resonance phase differs from zero under the resonant conditions. The results come from the interaction between the x-ray wave field and the resonant atoms.

We have shown the effects of anomalous dispersion (resonance) on X-ray multiple diffraction and the interference of X-ray wavefields with the resonant constituent atoms in the crystal at atomic absorption edges for the CdTe thin film on the InSb substrate. The effects on resonance phase due to the presence of a substrate were also considered in the diffraction/scattering process. By this analysis, the interfacial structure of the thin film system is expected be obtained from the x-ray multiple resonant diffraction.

Data.