Soft X-ray Three-Beam Resonance Diffraction from CdTe/InSb Interface

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Three-beam simultaneous diffraction of X-rays can provide phase information of structure-factor triplets involved in the diffraction process. By choosing the X-ray photon energy and the momentum transfers q_r along a given reflection, this type of diffraction can be used to investigate element specific interface structures of a thin film system. For a sample of a (100) CdTe thin film grown on a (100) InSb substrate, we employ respectively three-beam $(200/\bar{3}\,\bar{1}\,1)$ and $(200/111)$ diffraction to measure the phase shifts due to resonance at the Cd L_{III} and Te L_{III} absorption edges, where (222) is a symmetric reflection and $(\bar{3}\,\bar{1}\,1)$ and (111) are surface reflections. At different momentum transfers q_r along [200], sensitive to the interfacial structure, the phase shift in the resonant state also provides sufficient information about the distributions of Cd and Te concentrations. With a theoretical analysis for the crystallographic phase of the structure-factor triplets and the resonance phase shifts involved in the three-beam diffraction, it allows us to determine the composition of Cd and Te as a function of depth normal to the interface. With the propagation of the secondary $(\bar{3}\,\bar{1}\,1)$ and (111) reflected beams along the surface, possible interface structures parallel to the surface could also be deduced.