ELLIPSOMETRY OF TRANSPARENT CONDUCTING OXIDES FROM MID-INFRARED INTO VACUUM-ULTRAVIOLET

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Semiconducting metal oxides such as cubic In_2O_3, the various polytypes of Ga_2O_3, or rutile SnO_2 have attracted much interest in recent years. High-quality bulk crystals and single-crystalline heteroepitaxial films, covering a wide range of electron concentrations, became available allowing the determination of intrinsic optical properties as well as related fundamental band-structure parameters. This talk summarizes recent achievements.

Spectroscopic ellipsometry from the infrared (IR) into the vacuum-ultraviolet (VUV) spectral region is applied for determining the components of the dielectric tensor. The analysis of the IR dielectric function yields the phonon frequencies and the coupled phonon-plasmon modes from which electron effective mass as a function of carrier density (non-parabolicity of the conduction band) is obtained. Many-body effects such as exciton screening, band-gap renormalization, and band filling have a strong impact on the behavior around the fundamental band gaps, a quantitative description of these properties will be presented. Finally, synchrotron-based studies in VUV provide the transition energies related to critical points of the band structure.

Keywords: $(In,Ga,Al)_2O_3$; Band structure; effective mass, many-body effects