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Temperature dependent dielectric function of Ni

Abstract

In this seminar I present the optical properties of poly-crystalline and single-crystalline Ni at various temperatures from 80 K to 770 K. The measurements were taken using an FTIR-VASE ellipsometer from 1.5 μm to 40 μm and a VASE ellipsometer from 190 nm to 2.5 μm at angles of incidence of 65° to 75° in air and 70° in a UHV cryostat. For measurements in the cryostat, all samples were heat treated in UHV at 770 K for at least six hours. The optical constants of Ni are modeled using four Lorentzian oscillators representing the interband transitions and two Drude oscillators representing s- and d-electron conduction bands. The DC conductivity of Ni is extracted from the Drude parameters and compared with electrical measurements and a good agreement is observed. Two main absorption peaks near 1.5 eV and 4.8 eV in the optical conductivity of Ni are seen. The temperature dependence of the main absorption peak at 4.8 eV shows that this interband transition is affected by scattering with magnons with an effective energy of 77 meV. We interpret the reduction of the broadening of this peak as the ferromagnetic exchange energy, which is in good agreement with literature. The energy and the broadening of the absorption peak near 1.5 eV are found to be constant over the temperature range. Its amplitude decreases with temperature up to the Curie temperature (T_c = 627 K) and stays constant above this temperature. This behavior is explained by assigning the peak to $L_{3\downarrow} \rightarrow L_{3\downarrow}$ transitions.