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Laser Raman and resonance Raman spectroscopies of natural semiconductor mineral cinnabar, α-HgS, from various mines

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Abstract

Natural minerals α-HgS from various mines have been studied by laser Raman spectroscopy and resonance Raman spectroscopy. The crystals differ from each other in the content of selenium impurity, included in samples from some mines.

Based on the Raman spectra and the factor-group analysis the classification of the first order phonons and then the comparison of the results with the results from other works were carried out. The Raman spectra analysis of minerals from various mines show the selenium impurity gap vibration at 203 cm^{-1} and 226 cm^{-1} frequencies, respectively. On the basis of statistical measurements of the Raman spectra one can conclude that impurity frequencies of α-HgS may be generally used for the identification of the mine.

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Resonance Raman scattering for pure minerals has been studied by a dye laser. Phonon resonance in the indirect semiconductor α-HgS is found to be far more intense than the indirect resonance detected until now in various semiconductors in the proximity of the first indirect band E_g, for instance, in GaP. In our opinion, this may be conditioned by cinnabar band structure peculiarities.

Low resonance has also been fixed in 'dirty' minerals at the spectral band frequency of 203 cm^{-1} characterizing gap vibration of isomorphic impurity Se in cinnabar.

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