11.5-05 STOICHIOMETRIC VARIATIONS IN \text{Hg}_1-x \text{Cd}_x \text{Te} BY SELECTIVE X-RAY ABSORPTION.
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An incident beam of monochromatic x-radiation is selectively absorbed or transmitted as a function of elemental composition in the sample and then recorded on nuclear emulsion plates with a spatial resolution of 2 microns. For a specific wavelength \( \lambda_n \), \( \ln \left( \frac{I}{I_0} \right) \) may be expressed as \( \rho \cdot d \sum \sigma(Z, \lambda_n) \cdot r_Z \), where \( \rho \) is the atomic density, \( d \) is thickness, \( \sigma \) is the absorption cross section for \( Z \) at \( \lambda_n \), and \( r_Z \) is the percentage of \( Z \) in the mixture. When the experiment is conducted for \( n \) unique wavelengths, a set of \( n \) linear simultaneous equations is obtained which relate the intensity ratio at a given point to the composition. A solution for \( r_Z \) exists when the \( n \) equations are linearly independent. This condition is satisfied by choosing the \( n \) unique wavelengths separated by the \( n-1 \) absorption edges of the elements in the mixture. A three color image, generated directly from the nuclear plates, exhibits color as a function of elemental composition vividly exhibits the percentage of \( Z \) in the mixture. This novel method of characterizing composition is used for \( x \)-ray diffraction and calculus. The experimental technique includes the use of multiple diffraction where the primary reflection is forbidden by the space group as well as the preferential excitation of the impurity atoms by anomalous dispersion. Since these impurity atoms cannot be distributed in accordance with the space group of the crystal one expects some energy to appear in these forbidden places. The obvious advantage of the method over those where the measurements are made on Bragg peaks (e.g., Duncan, Freeman & Johnston, in Anomalous Scattering, p.163-173, Abrahams and Reamesserh Eds. (1975)) lies in the enormous increase in the signal-to-noise ratio, since in our method the measurements are performed around positions where the background is several orders of magnitude lower.

In order to obtain the intensities diffracted in these forbidden places by the impurity atoms we had to extend the multiple scattering theory for mosaic crystals (Cattaneo-Ellis 1961 Acta Cryst.A 25,666). The study was made both for interstitial and for substitutional impurity atoms which were supposed to be of just one class. Since the impurity contribution to the intensity is very low, the resultant signal is frequently nearly lost in the noise. In order to increase the detectability of the method used the same method as applied after repeating periodically many times the step scanning measurements over a selected angular region. The fact that the position of the signal is known permits the use of this mathematical technique for a function of known period and sometimes the recovery of the shape of the peak.

Actual measurements were done on a sample of rutile before and after doping it with Fe. The limits of detectability have as for Cattaneo-Ellis been established for they depend obviously on the number of repetitions and on the time spent on each point. Typically, for data measured about one thousand times, the increase in the signal-to-noise ratio is close to the theoretically expected one of about 30 decibels.

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