11.5-05 STOICHIOMETRIC VARIATIONS IN Hg_{1-x} Cd_x Te BY SELECTIVE X-RAY ABSORPTION.
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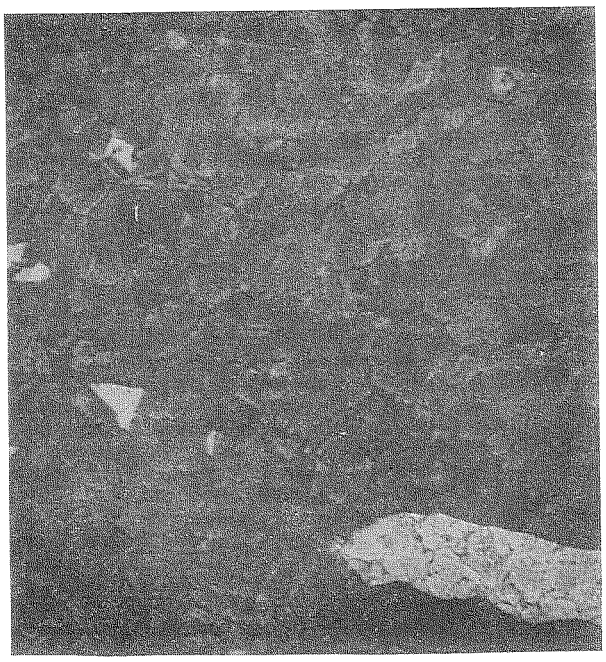
An incident beam of monochromatic x-radiation is selectively absorbed or transmitted as a function of elemental composition in the sample and then recorded on nuclear emulsion plates with a spatial resolution of 2 microns. For a specific wavelength λ_n: Ln (I/I_o) may be expressed as $\rho' \cdot d \sum_Z \sigma(Z,\lambda) \cdot r_Z$, where ρ' is the atomic density, d = thickness, σ is the absorption cross section for Z at λ_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 atomic composition. This novel method of characterizing composition vividly exhibits the Te and Hg precipitation and the mixed crystal nature of the wafer (see photo).
The experimental and color techniques as well as the methods of calculating the atomic ratios and associated errors will be discussed in detail.



The color figure (above) was generated from two nuclear emulsion images of the same sample with different wavelength radiations. Color (contrast) is exhibited because of selective absorption by Hg and Te.

11.5-06 A NEW DIFFRACTION METHOD TO LOCALIZE IMPURITY ATOMS IN A CRYSTAL LATTICE.
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A new method to localize the doping atoms in a crystal lattice has been devised by making use of several advanced techniques of 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 this place of the secondary forbidden reflections, especially of those where the coupling factor is high. 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 Ramaseshan 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 (Caticha-Ellis (1969) Acta Cryst.A 25,666). This study was made both for interstitial and for substitutional 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 use is made of the calculus of autocorrelation and/or intercorrelation, which are 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. No limits of detectability have so far 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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