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Identification of copper precipitation in single crystal silicon using the CAMECA Ion Analyser

Infra-red microscopy can be used [1] as an indication of precipitation on crystallographic planes in copper-doped silicon; an example of such a micrograph is given in Fig. 1 where three families of precipitation on (110) and (111) planes can be seen intersecting the (111) surface of a silicon slice containing 10^{18} to 10^{19} atoms/cc of copper.

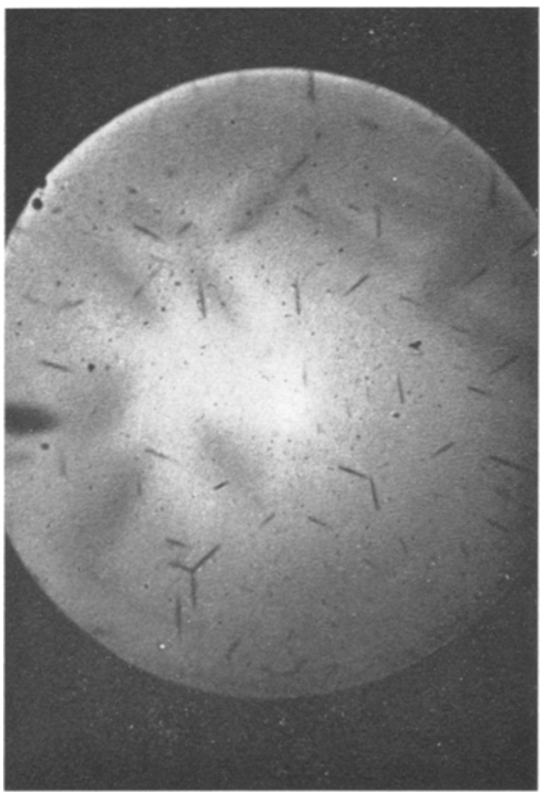

Figure 1 Infra-red micrograph of (111) silicon single crystal slice (× 275).

Identification of the precipitates as copper-rich material has now been achieved using a CAMECA IMS 300 Ion Analyser [2] with oxygen as the primary bombarding beam. Fig. 2 shows an image obtained in Cu^+ ions in the secondary ion spectrum from the surface of a sample similar to that used in the preparation of Fig. 1; three families of precipitation are again apparent and it is clear that the precipitates are copper-rich.

This example of the use of the ion analyser is

Figure 2 Cu^+ion-analyser image of copper in (111) silicon slice. Primary O^+ beam (× 240).

particularly interesting in view of the relatively poor sensitivity of the technique for the noble metals Cu, Ag, Pt, Au, etc., when using bombardment with ions of the usual gases argon, nitrogen, or oxygen. It is sometimes possible to achieve better sensitivity by observing the negative ions of these elements [3] and it is hoped to apply the ion analyser in this mode to studies of the distribution of other additives such as gold in the near future.

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Short notices

Electronic Structures of Point Defects
G. K. Wertheim, A. Hausmann and W. Sander
North-Holland, Amsterdam (1971). Dfl. 65.00 ($20.25 approx)

This is the third book in the series on Defects in Crystalline Solids, edited by Amelinckx, Gevers and Nihoul, and is in two parts. Both are concerned with the study of crystal defects, the first part by Wertheim dealing with applications of the Mössbauer effect, and the second, by Hausmann and Sander, on spin resonance methods.

Mössbauer spectrometry depends upon the resonant absorption of very sharply monochromatic gamma rays, the gamma ray source and the crystal absorber undergoing the same nuclear transition. The energy of the gamma rays emitted by the source is Doppler – modulated by mechanically moving the source, and the transmitted gamma rays are detected by a proportional counter connected to a multi-channel analyser, so that absorption peaks can be located Structural information is derived from the magnitude of the Doppler shift at peak positions.

Today there are a whole variety of defects which can be studied using the Mössbauer effect. For example, radiation-damaged source material, which was originally considered a problem in gamma ray sources, is now itself a topic of study. Investigations have, for example, been made of the damage associated with ion implantation. The technique has been applied to defects in alkali halide crystals, especially aliovalent-doped crystals, confirming many of the findings obtained by other methods regarding the association of extrinsic vacancies with impurity ions. (Co^{2+} is the most commonly used impurity.) In metallic systems, long and short-range ordering has been followed by the Mössbauer effect, so too have the complex transformations in Fe/C alloys following the tempering of martensite. In this monograph numerous examples are given of experimental applications of the Mössbauer effect and the principal findings listed.

The monograph on spin resonance first of all gives a description of *electron spin paramagnetism*, *electron nuclear double resonance* and *nuclear magnetic resonance*. This is followed by an account of experiments using spin resonance to study colour centres in alkali halides including impurity centres, and paramagnetic defects in II-IV compounds, III-V semiconducting compounds, group IV elements and compounds and in a number of oxide crystals. As in the first monograph, the principal experimental findings are described briefly and many subjects covered.

It is not altogether clear to whom these monographs, which in the main part describe a wide range of experimental findings based on a