11.2-04 DEFECTS IN METALS AND ALLOYS STUDIED BY NEUTRON SMALL-ANGLE SCATTERING.
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Some recent applications of neutron small-angle scattering (SAS) to the study of voids and precipitate zones in metal and alloy single crystals will be discussed. The experiments were performed at the Institut Laue-Langevin, Grenoble, France, in collaboration with laboratories at the University of Göttingen, Germany (Prof. P. Haasen), at Tampere University of Technology, Tampere, Finland (Prof. P.O. Kettunen), and at the Max-Planck-Institut für Metallforschung, Institut für Werkstoffwissenschaften, Stuttgart, Germany (Prof. V. Gerold).

In fatigued Cu single crystals, weak SAS is observed. Part of this scattering is due to dislocations, but another contribution can be related to small voids, about 2 nm in diameter, formed in the persistent slip bands upon fatigue.

In Al-Zn it is known, e.g. from SAS and from the analysis of the diffuse scattering around Bragg peaks, that the metastable precipitates (Guinier-Preston zones) formed after quenching a solid solution to temperatures near room temperature are coherent zones rich in Zn. For zone diameters less than about 5 nm, the zones appear spherical. An extensive neutron SAS study on Al-(6.8 at.%) Zn single crystals with {110} and {100} faces perpendicular to the incident beam, however, showed "anisotropic" SAS - easily revealed on a two-dimensional position-sensitive detector - even for smaller average zone diameters. Distinct scattering maxima along <110> appear in the well-known scattering ring, indicating a preferred arrangement of zones along certain crystallographic axes.

In Ni-Al, very stable ordered and coherent precipitates (Ni_3Al) give rise to good mechanical strength at elevated temperatures. Neutron SAS from Ni-(12 at.%) Al and Ni-(14 at.%) Al single crystals with {110} faces, aged between 550°C and 625°C, shows pronounced maxima along <100> that are again related to spatial correlations in the precipitate arrangement. These data for the early stages of decomposition complement results obtained by other authors by transmission electron microscopy of samples containing larger precipitates.

11.2-05 HYDROGEN-INDUCED DEFECTS IN FZ SILICON CRYSTAL.
By Mai Zhenhong, Cui Shufan and Ge Peiwen, Institute of Physics, Chinese Academy of Sciences, Tsien Lingchao, University of Sciences and Technology of China.

FZ silicon crystals grown in hydrogen atmosphere were investigated by means of X-ray topography, infrared absorption spectroscopy, infrared microscopy and electron microscopy. The presence of Si-H bonds in the crystals was confirmed by measurements of infrared absorption spectra. Besides three characteristic infrared absorption peaks at 2219, 2131 and 1949 cm^{-1} in the stretching region, which were reported in our previous paper, four new characteristic absorption peaks were revealed at 812, 791, 634 and 548 cm^{-1} in the bend and wag regions. As the temperature of the crystals is raised, the Si-H bonds break down and the supersaturated hydrogen atoms precipitate out to form clusters in the crystals. High pressure in the clusters above 600 °C makes the dislocations glide in six directions on the (111) plane. They present beautiful "snowflake-like" patterns by X-ray topography. The results of positron annihilation experiments suggest that the hydrogen atoms in silicon lattice might be situated on several interstitial sites. The process of the formation of hydrogen-induced defects is discussed.

11.2-06 DIFFUSE X-RAY SCATTERING FROM ABRASION INDUCED SMALL DEFECTS IN SILICON.
By S. Yasuami, Toshiba R & D Center, Saiwai-ku, Kawasaki, Japan, and N. Kashiwakura and J. Harada, Department of Applied Physics, Nagoya University, Chikusa-ku, Nagoya, Japan.

Two kinds of EDSs (Extra Diffuse Scattering) were observed for a silicon crystal shaped by polishing surfaces with #2000 white alundum and 30∿60 μm etching. One EDS forms a cigar shape elongation along the [111] direction from reciprocal lattice points; the other is disk shaped, broad and perpendicular to the [111] direction. The cigar shaped EDS is asymmetric around the 111 reciprocal lattice point along the [111] direction. This fact indicates that the lattice relaxation in the defect is contraction.
By applying simple Fourier analysis to these EDSs, two kinds of small defects were found to exist. They are a lattice contraction plate like defect[200Å(φ)x30Å(t)], extending in the (111) plane, and a needle like defect [400Å(l)] along the [111] direction.
The EDSs were observed only for the {111} surfaced crystals but not for the {100} and the {110} surfaced crystals. The EDSs disappeared after further etching the crystal by about 120 μm. The defects are, therefore, considered to be introduced during surface polishing process. Since the {111} planes are the cleavage planes for silicon crystals, the plate like defect is assumed to be cleavage microcrack.
In characterizing the surface, the diffuse X-ray scattering method is much more sensitive than the rocking curve for detecting defects concerned.