The line shape of the ultrasonically induced resonance broadens and the ratio of signal strength to ultrasonic power decreases with increasing transducer voltage, due to saturation of the nuclear spin-levels. The unsaturated line width of the resonance is difficult to detect with the present experimental equipment but is approximately 25 gauss for the copper-63 resonance and 50 gauss for the copper-65 resonance. Both lines are shifted to higher field values from that corresponding to the ultrasonic frequency equal to twice the Larmor frequency, by 85 gauss and 170 gauss respectively. The relative sensitivities of the two lines can be estimated both from the strength of the absorption signal and the signal necessary to saturate the resonances. The ratio in both cases is approximately 2·3:1, in agreement with the isotopic abundance ratio.

Quantitative experiments are to be carried out with an improved experimental system, and the theoretical possibility that the line width observed may be due to exchange interaction between the nuclei via the conduction electrons[6,7] is being investigated.

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Dislocation Loops in Irradiated Iron

It has been suggested many times that the hardening of iron and steel on irradiation may result from the interaction of glide dislocations with dispersed clusters of point defects. Two observations of such clusters using the technique of transmission electron microscopy have been reported in the literature[1,2]. The work reported in this communication was undertaken to determine the crystallography of dislocation loops observed in pure iron.

Thin foils of iron (approx. 1000 Å thick) were irradiated with protons and Fe^+ ions of energy 150 KeV at temperatures in the range 20°–600° C. Dislocation loops produced by this treatment had diameters ranging from 50 Å at low temperatures to 1500 Å at the higher temperatures. The projected shape of the loops was elliptical in the proton irradiated foils and lozenge shaped in the foils irradiated with Fe^+ ions.

A full crystallographic analysis has so far only been made for loops produced by irradiating with Fe^+ ions to a total dose of $\sim 1{\cdot}7 \times 10^{16}$ ions/cm² at a rate of $\sim 4 \times 10^{14}$ ions/cm²sec. The specimen temperature was 500°–600° C.

The crystallographic directions of the sides of the loop were determined by measuring the projected directions of the loop sides in a plane perpendicular to the electron beam. On tilting the specimen through a large angle and repeating this procedure, the true directions of the sides were found. Determining the directions of a pair of non-parallel sides gave the plane of the loop unambiguously. All the observed loops were shown to be square, lying on $\{100\}$ planes with sides in the $\langle 100 \rangle$ directions. Sometimes loops were observed edge on and in these cases it has been possible to confirm that their poles lay very close to $\langle 100 \rangle$.

The Burgers vectors of the loops were determined uniquely by the standard diffraction contrast technique as pure $\langle 100 \rangle$ edge dislocations[3]. In the absence of any diffraction contrast within the loops which would indicate the presence of a stacking fault, it is likely that the Burgers vector is $a \langle 100 \rangle$.

The sense of the Burgers vector defines whether the dislocation loop has been formed by the condensation of vacancies or of interstitial atoms. Methods[4,5] of determining the sense of b from diffraction contrast observations confirm that the loops result from the condensation of interstitial clusters.

Estimates of the energies of various modes of condensation of point defects in the body-centred-cubic lattice indicate that the observed mode has low energy. Other low-energy modes have $b = \frac{1}{2}a \langle 111 \rangle$: since this is the slip vector, such loops may be sucked out of the foil by the image forces and hence would not be observed.

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METALLURGY

X-ray Asterism and Work-hardening in Crystals

This communication reports some observations pertaining to an experiment on the plastic behaviour of age-hardenable alloy single crystals. The experiment formed a part of a senior year laboratory course and was intended to illustrate the strengthening effects due to well-known[1] precipitates in aluminium base copper alloys and also the fact that predictable lattice rotations are obtained for a given amount of tensile deformation in cases where only one slip system prevails[2]. To this end it was planned that a number of crystals would be grown, their orientations determined, various heat treatments performed and elongations predetermined so as to give limited amounts of crystal rotation on the $\langle 110 \rangle \{111\}$-system which could be checked by a second orientation determination after tensile deformation.

It was found possible to grow single crystals of commercial 'Alcoa 2011' alloy by the strain anneal technique in spite of the high impurity concentration. The nominal composition of this alloy is copper 5·5 per cent, lead 0·5 per cent, bismuth 0·5 per cent, silicon 0·4 per cent, iron 0·7 per cent, and zinc 0·3 per cent with the balance aluminium. Half-inch diameter rod was rolled to a reduction of 57 per cent. Tensile specimens were then machined, given a 5-min anneal at 550° C, pre-strained 2 per cent in tension and lowered into a 550° C salt bath at a rate of 0·5 in./h. This produced single crystals throughout gauge-lengths several inches long. Six crystals were given heat treatments which produce well-known[1] conditions in pure binary aluminium base copper alloys. These were: (*a*) Guinier–Preston zones of the first kind (*GPI*). The first coherent metastable decomposition product of the supersaturated solid solution—quench plus age 24 h at 130° C; (*b*) Guinier–Preston zones of the second kind (*GPII*)—quench plus age 24 h at 190° C; (*c*) θ′ (first over-aged, partially incoherent metastable precipitate)—quench plus age 24 h at 240° C; (*d*) θ, the equilibrium precipitate—quench plus age 24 h at 460° C; (*e*) θ, as produced by slow furnace cool from 550° C; (*f*) supersaturated solid solution—quench from 550° C. Treatments *e* and *f* presumably yield θ and the supersaturated solid solution respectively. Each crystal was then deformed in tension at 300° K in an 'Instron' testing machine at a rate of about 10^{-3} sec^{-1}.

Pure binary aluminium–copper crystals, either as quenched or containing *GPI* or *GPII* zones, show crystal rotations characteristic of slip on only one system of the