X-Ray Investigations of Lattice Defects on Certain F.C.C. and B.C.C. Metals and Hexagonal Gold-cadmium Alloys

By

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PREFACE

The primary result of the deformation of a metal is the disruption in the periodicity of the lattice. A small change in the atomic arrangement causes appreciable change in some of the important physical properties of solids. Since the diffraction of x-rays is based upon the periodicity of the lattice, the study of deformed material should disclose basic information about the nature of defect structure that is produced. According to the dynamical theory of x-ray diffraction, the intensity of monochromatic x-ray diffraction in a large perfect crystal should differ from zero only in narrow angular regions of the order of few seconds of arc in width spread around the Bragg reflection angle. In actual practice, however, the actual intensities spread over a range of minutes of arc. The broadening of the lines is due to lattice imperfections and the quantitative study of it gives the extent of various lattice defects.

In course of the present studies, the x-ray diffraction line profiles of copper, aluminium, silver, molybdenum and three hexagonal gold-cadmium alloys (27 at.% Cd, 28 at.% Cd and 29 at.% Cd) have been investigated. The aim of the work on f.c.c. and b.c.c. metals was to study and analyse the pure x-ray diffraction line profiles from filed specimens. The quantitative separation of the various factors contributing to the line broadening has been carried out by line shape as well as integral line breadth analysis. Changes in the defect concentration have been achieved by gradual annealing of the cold-worked specimens. The effect of annealing on different parameters viz. domain size, lattice strain and stacking fault has been studied. The activation energy for recovery in molybdenum has been determined from the isothermal annealing curves.

The study on hexagonal gold-cadmium system is interesting as 27 at.% Cd, 28 at.% Cd and 29 at.% Cd alloys are heavily faulted. The present investigation seeks to determine the nature of stacking fault density variation with cadmium content. This system has been chosen because the hexagonal phase is stable at room temperature and there is no evidence of phase transformation occuring after deformation.

The publications resulting from the above investigation are given below:

1. "Structural Imperfections in Hexagonal Gold-cadmium Alloys" - to be published in Acta Crystallographica, (Jan. 1968).

2. "Stacking faults in Hexagonal Gold-cadmium Alloys" - to be published in the Journal of Applied Physics (U.S.A.), (Feb. 1968).

3. "Activation Energy for Recovery in Cold-worked Molybdenum" - to be published in Philosophical Magazine (London), (1968).

4. "Domain Size and Lattice Strain in Molybdenum" to be published in Brit. Jour. Appl. Phys., (1968).

These references have been given in the text.

The earlier work of the author on the Geiger-counter x-ray diffractometer [Nature (London), 1964, 203, 177; Philosophical Magazine, 1963, 8, 1161.] at the Indian Institute of Technology, Kharagpur, has not been included in this thesis as the facility could not be availed of for a long time due to the appointment at I.I.T. Delhi.

C O N T E N T S

Page