Bull. Mater. Sci., Vol. 19, No. 3, June 1996, pp. 601–605. © Printed in India.

RAPID COMMUNICATION

The effect of uniaxial stress component on the lattice strains measured by a diffraction method using opposed anvil device: trigonal system

A K SINGH and C BALASINGH
Materials Science Division, National Aerospace Laboratories, Bangalore 560 017, India

MS received 11 April 1996

Abstract. The equations have been derived for the trigonal system to calculate the lattice strains produced by the non-hydrostatic pressure condition which arises when the sample is compressed between the anvils without any pressure transmitting medium.

Keywords. Uniaxial stress component; lattice strains; opposed anvil device; trigonal system.

1. Introduction

The lattice strains as a function of pressure can be measured by recording X-ray diffraction patterns from the specimen compressed in an opposed anvil device such as a diamond anvil cell. When the specimen is compressed between the anvils without any pressure transmitting medium, the stress state at the centre of the specimen, σ_{ij}, is non-hydrostatic. In recent articles generalized theories using anisotropic elasticity theory were developed for cubic (Singh 1993) and hexagonal (Singh and Balasingh 1994) systems to calculate the lattice strains which correspond to the strains measured under non-hydrostatic pressure condition. Recently, Mao *et al* (1995) developed a new technique to measure the *d*-spacings as a function of ψ (ψ being the angle between the diffracting plane normal and the direction of the applied load) and collected the data for the cubic and trigonal phases of Wustite. The interpretation of such data will require an expression for trigonal system to calculate the lattice strains under non-hydrostatic condition. In this article, we derive the relevant equations for the trigonal system in a form suitable for the analysis of the experimental data. The method followed in the derivation of the equations is given in detail in the earlier papers (Singh 1993; Singh and Balasingh 1994).

2. Stress state

The stress state, σ_{ij}, at the centre of the specimen compressed in an opposed anvil device is defined by the radial component (in the plane of the anvil face) σ_1 and the axial component (along the direction of the applied load) σ_3. The difference $(\sigma_3 - \sigma_1)$ denoted by t, has been termed as uniaxial stress component. The stress state at the centre of the specimen is completely described by

$$\sigma_{ij} = \begin{bmatrix} \sigma_1 & 0 & 0 \\ 0 & \sigma_1 & 0 \\ 0 & 0 & \sigma_3 \end{bmatrix}$$

$$= \begin{bmatrix} \sigma_p & 0 & 0 \\ 0 & \sigma_p & 0 \\ 0 & 0 & \sigma_p \end{bmatrix} + \begin{bmatrix} -\frac{t}{3} & 0 & 0 \\ 0 & -\frac{t}{3} & 0 \\ 0 & 0 & \frac{2t}{3} \end{bmatrix}$$