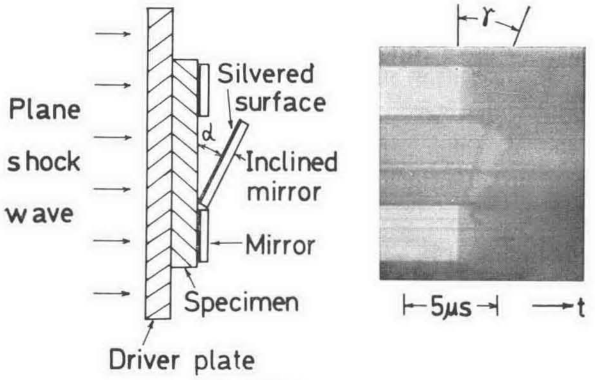

Fig. 10(a)

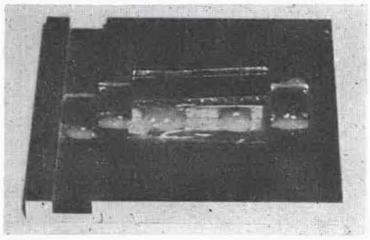

Fig. 10(b)

Fig. 10. Inclined mirror technique for measuring the free surface velocity
(a) The experimental set and its streak record (Specimen: Fe)
(b) Photograph of the experimental set (Specimen: GaAs)

$$u_f = W \tan \alpha / M \tan \gamma \,, \tag{6}$$

where W and M are the writing speed and the magnification of the streak camera, respectively. The inclined mirror technique is sensitive to the planarity of the shock wave front, and so it has been used only with the in-contact plane wave generator.

Figure 10(b) shows an experimental set for the study on shock compression of GaAs[10], in which the multiple shock wave due to the phase transformation is expected. The dimension of the sample is about 12 mm×25 mm×3 mm. The inclined mirror is set with an angle of about 3°30′, which is measured with a precision of $\pm 2'$.

If a double shock wave has passed through the specimen, the streak record must show a kink in the free surface trace, as shown schematically in Fig. 11. The slopes of the first and second traces correspond to the free surface velocities due to the first and second waves, respectively. The shock and free surface velocities of the first and second waves are given by the following equations:

$$U_1 = d/(t_1 - t_0) \tag{7a}$$

$$u_{f1} = W \tan \alpha / M \tan \gamma_1 \tag{7b}$$

$$U_2 = d + u_{f1}(t_2 - t_1)/(t_2 - t_0) \tag{8a}$$

$$u_{f2} = W \tan \alpha / M \tan \gamma_2 \,, \tag{8b}$$

where d is the thickness of the specimen, t_0 is the time of incidence of shock wave into the sample, t_1 and t_2 are the arrival times of two successive shock waves on the free surface of the specimen. Here, the subscripts 1 and 2 correspond to the first and second waves, respectively. On the basis of the free surface approximation, particle velocities are obtained from free surface velocities, i.e. $u_{f1} = 2u_1$, $u_{f2} = 2u_2$. Shock pressures and densities of the sample, (P_1, ρ_1) and (P_2, ρ_2), correspond-

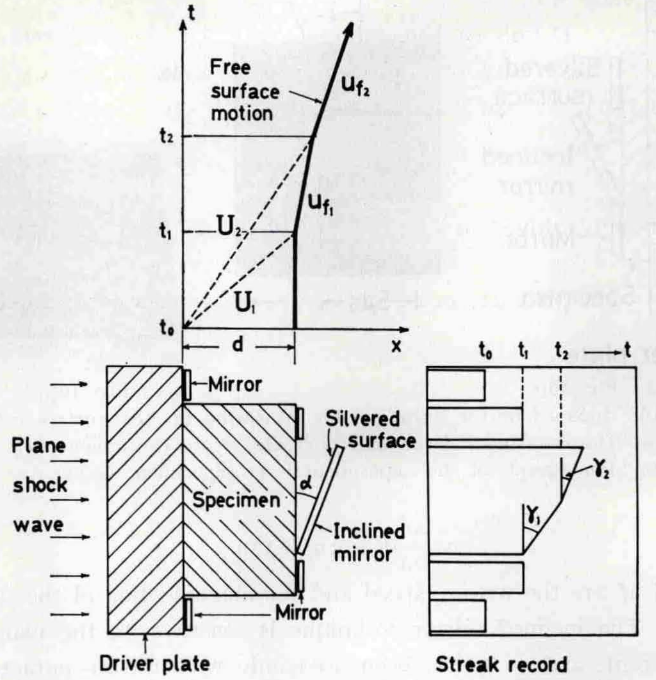

Fig. 11. Schematic illustration of an inclined mirror experimental record for a double shock wave

ing to the states (u_1, U_1) and (u_2, U_2) are given by the following equations which are easily derived from eqs. (1) and (2):

$$P_1 = \rho_0 U_1 u_1 \tag{9a}$$

$$\rho_1 = \rho_0 U_1 / (U_1 - u_1) \tag{9b}$$

$$P_2 = P_1 + \rho_1 (U_2 - u_1)(u_2 - u_1) \tag{10a}$$

$$\rho_2 = \rho_1 (U_2 - u_1) / (U_2 - u_2) \,. \tag{10b}$$

Using both the argon flash gap technique and the inclined mirror technique, shock compression experiments have been performed for Fe_3O_4[9], αFe_2O_3[9] and GaAs[10]. An inclined mirror record for Fe_3O_4 catches a double shock wave structure associated with a high-pressure phase transition. Its pressure is determined to be 220±20 kbar, which is slightly lower than that obtained by static high pressure experiments[18]. For αFe_2O_3, on the other hand, no evidence for phase transition is found at pressures up to about 500 kbar. Inclined mirror experiments of GaAs at 220 and 262 kbar exhibit three distinct waves: an elastic precursor wave and a double shock wave associated with a phase transition occurring at high pressure. From the analysis of the records, the Hugoniot elastic

(18) H.K. Mao, T. Takahashi, W.A. Bassett, G.L. Kinsland and L. Merill, J. geophys. Res., **79** (1974), 1165.