transmitted through the specimen. Experiments of the second type measured the stress history at the impact surface of a BaF_2 specimen before reflections returned. Experiments of the third type were designed to recover a specimen of BaF_2 subjected to shock compression stresses well above the pressure of transformation at room temperature. The results of these experiments are described in the following section.

IV. EXPERIMENTAL RESULTS

Front Surface Impact

In these experiments a stress gage records the jump in stress (σ_i) impressed upon a specimen at the impact surface because the quartz gage impactor is also the transducer.[16,17,18,19] The magnitude of this jump is calculated directly from the piezoelectric response of the gage.[20] For the configuration shown in Fig. 1, particle velocity in the quartz gage at the interface, is determined by the relation

$$u_q = \sigma_i/\rho_q D_q \tag{1}$$

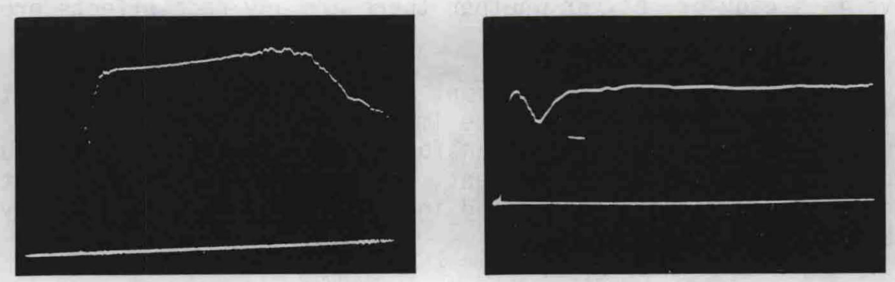
where ρ_q and D_q are density and elastic longitudinal velocity in quartz, respectively. Since both stress and particle velocity are continuous at the impact interface, the pair of values (σ_i, u_q) also apply to the BaF_2. However, since BaF_2 has the initial velocity, u_o, the physically significant velocity is

$$u_s = u_o - u_q. \tag{2}$$

Therefore the values tabulated as being characteristic of BaF_2 under the impact conditions are (σ_i, u_s). The characterization of a material in the above manner is valid whether the profile of the wave is steady or not, or whether there are any rate effects present or not.

As shown by Hayes,[19] in front surface impact the rate of stress relaxation at the impact surface immediately after impact is directly related to initial transformation rate at the impact surface. If a relaxation is present, the post-relaxation stress at the impact surface is propagated into the specimen with a steady profile.

In the present set of experiments, steady stress profiles were obtained only below $\sim$24 kbars, i.e. probably below the stress at which β-BaF_2 transforms to α-BaF_2. At higher stresses, stress profiles obtained at the impact surface for specimens oriented along <111> show a unique type of profile never before reported. These show that the stress initially rises, then goes through a minimum, and finally attains a steady state. A profile so obtained, with 40 kbar peak stress, is shown in Fig. 2, as recorded on two different oscilloscopes. Figure 2 also shows that the initial stress rise is very sensitive to the response of the electronic instrument used in the experiment. Figure 2(a) was recorded on a Tektronix oscilloscope Type 454 with 150 MHz bandwidth, and Fig. 2(b) was recorded on a Tektronix oscilloscope Type 519 with 1000 MHz bandwidth. This is important to remember because it implies that the initial record of a stress history does not necessarily reflect the mechanical property of the material. It may reflect the speed of the oscilloscope response to a signal. However, the magnitude of minima and subsequent steady state stress levels are insensitive to the type of oscilloscope used. Moreover, these stress profiles have been reproduced in identical experiments. Calculation of the impact stress for elastic compression of the β-phase indicates that the magnitude of initial stress is equal to the steady state value. However, the data present a difficult problem of interpretation because, on the basis of a standard stress-particle velocity (σ-u) diagram for a material which exhibits a phase transition under high pressure, shocking up of the stress profile after an initial relaxation is impossible. For example, consider a typical σ-u diagram for a front surface impact experiment in which the specimen is stationary, (Fig. 3). Let OA and ABC, parts of the curve OABC, represent the stable and metastable part of the σ-u profile for phase I of a material. Let AB'C' represent a similar profile for stable phase II of the material. Let the transition stress be σ_A. If a quartz gage with a velocity u_0 is impacted on the specimen in phase I so as to generate a stress σ_B, then if the transformation to phase II is instantaneous or faster than the rise time of the recording instrument, the impact stress profile would be of magnitude $\sigma_{B'}$. However, if the rate of transformation is slower than



(a) (b)

Fig. 2 -- Stress-time profile for shock compression of BaF_2 in <111> direction. The impact stress in both cases is 40 kbars.
(a) The profile recorded on Tektronix Type 454 oscilloscope.
(b) The profile recorded on Tektronix Type 519 oscilloscope.