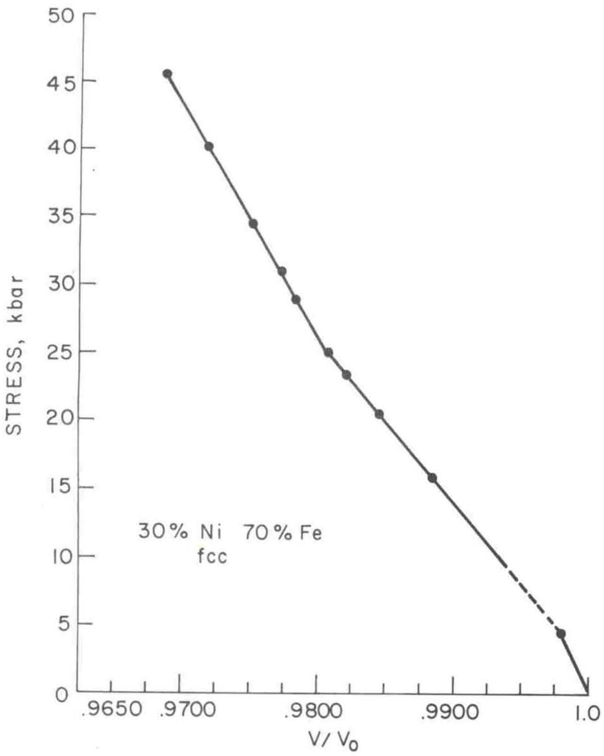

Fig. 12 Stress-volume relation observed for fcc 30%Ni-70%Fe

the foregoing except that the shock wave is produced by the impact of a quartz gage. This experimental arrangement is shown in Fig.11. Provisions are made to obtain the signal from the projectile gage with the result that the stress and particle velocity are obtained at the impact surface as well as the data ordinarily obtained at the rear surface of the specimen disk. Thus, with this experimental arrangement, two completely independent sets of measurements are made on each experiment. This unique capability of directly measuring the shock-wave properties with two entirely independent methods on the same experiment is a particularly valuable feature. For these experiments, the most complete data were available from the quartz gage at the rear of the specimen, and the impact-surface data were used to verify the rear-surface data.

The stress-volume relation obtained is shown in Fig.12. As is anticipated for a second-order phase transition, a well-defined change in compressibility is observed at 25 kbar. The cusp at 4 kbar is the Hugoniot elastic limit. In order to accurately determine the critical stress at the transition, it was again essential to have the capability of achieving preselected impact velocities in the immediate vicinity of the transition.

The results and their interpretation have been fully reported elsewhere (36). In summary, however, it was possible to identify the sharp change in compressibility as a pressure-induced ferromagnetic to paramagnetic transition with values in agreement with the extrapolation of previous lower pressure results. From the Ehrenfest relation, it was possible also to calculate the change of specific heat and thermal expansion at the transition from the measured change in compressibility and the pressure coefficient of Curie temperature.

SUMMARY

The measurements described here were accomplished with various experimental arrangements chosen to obtain maximum utility from the capabilities of the impact experiment. These capabilities taken individually are valuable and, more significantly, when combined, provide new experimental capability which is especially well suited for the study of the physical properties of solids under shock-wave loading. From a consideration of these measurements utilizing impact techniques and a comparison with measurements which seem possible with explosive loading experiments, the new experimental conditions which characterize impact experiments can be summarized as follows:

1 The impact experiment is a conceptually simple, easily repeated experiment which imparts well-defined input conditions to a specimen.

2 The impact experiment provides virtually continuous values of stress for application to a specimen.

3 By utilizing the symmetrical impact condition, experimental arrangements are possible which provide intimate connection between the measurement of the applied stress and the measurement of the stress-induced physical property change.

4 The symmetrical impact condition and the velocity control permit more flexibility in choosing experimental arrangements which avoid the serious wave interaction problems inherent in free-surface velocity experiments.

5 The lower limit of the stress range available for investigation is lowered to a few kilobars.

For the measurements performed to date, the most useful and definitive data were obtained in the elastic range, which for brittle anisotropic materials extends to high stresses. Within the elastic range, the one-dimensional strain configuration imposed by shock-wave compression allows determination of physical property changes resultng from large deformation along specific crystal-ographic directions. Unfortunately, except for ompressibility determinations, the experiments onducted for stresses in excess of the elastic imit have not yielded precise well-defined data. he desirable experimental conditions described n the foregoing are also supplemented by practi-al considerations of safety and low electrical oise levels.

With these experimental conditions, it has een possible to measure physical properties under arge compressions which complement measurements ade under static high pressures. The measurements reported are extensive and diverse; an techniques are well enough developed such th seems likely that impact techniques will pla increasingly important role in the study of properties of solids under large compressio

ACKNOWLEDGMENTS

The author is indebted to G. E. Ingram technical assistance in developing the vari experimental arrangements, and to numerous S Laboratory colleagues for suggestions and di sions.

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