$= -3{\cdot}1 \times 10^{-2}$ kb
in using atmos-
the temperature
d accuracy of the
alue of dP/dT is
of our transition
data. Further, the
least an order of
of the phase line
o liquid observed
the solid to liquid
id–solid transition
ate measurements
ver the measure-
and very small[17]
ation. The present
rphic transition in
surement made to

e for dP/dT and for
accompanying the
enthalpy change,
nsition from the

.... (4)

5 cal/g which when
nt heat of fusion of
h too small to be
thesis.
of the shock com-
compared to static
ly illustrate that the
olid transition with
with those obtained
the white tin struc-
ompute the slope of
e velocity measure-
region. We find no
ases[21,22] below the
experiment includes
nent the agreement
tatic values indicates
enced by shear.

3
ESULTS
bserved in the shock
ults in large (2·5%)

Table 3. Characteristics of the polymorphic transition in Ge

	Static data	Present work
Transition pressure (kb)	120–125[a]	114–122
Specific volume	$0{\cdot}875\ V_0$[b]	$0{\cdot}870\ V_0$–$0{\cdot}880\ V_0$[e]
Temperature (°C)	20	160[c]
$\Delta V/V$	20·7%[b]	—
dP/dT (kb °C^{-1})	—	$-3{\cdot}1 \times 10^{-2}$
ΔH (cal g^{-1})	—	12·5[d]

(a) Ref. 10.
(b) Ref. 16.
(c) As estimated by McQueen, Ref. 13.
(d) Calculated using ΔV given by Jamieson, Ref. 16.
(e) Corrected to 20°C for comparison with static data.

one-dimensional elastic compressions which are uniquely achieved in the shock wave loading experiments. Resistivity measurements for large uniaxial elastic strains are of interest since they may be useful for confirming the theoretical calculations of KLEINMAN[2] and GOROFF and KLEINMAN[3] which predict the effect of a general strain tensor on the energy bands of silicon, and by inference, germanium. These measurements may also help to describe the so-called "anisotropic stress effect" observed for stressed semiconductor *p–n* junctions.[23]

The component of the energy gap change induced by volumetric compression has been verified by hydrostatic experiments, but the component of energy gap change induced by shear strain has not been verified since large shear strain components cannot be applied statically to brittle materials such as germanium. If the germanium samples behave intrinsically for large shear strain, it is possible that the resistivity measurements under shock compression can provide a measure of the energy gap change induced by shear strain. The conditions imposed on the sample by plane-wave shock loading in the elastic range are well defined allowing all stress and strain components to be accurately evaluated. Further, since the compressions are small the process is adiabatic to a very close approximation and accurate calculations can be made of the slight temperature rise (5·6°K at 44 kb)* induced by shock wave.

* The temperature of the shocked Ge in the elastic range is computed as $T = T_0(V_0/V)^\gamma$. Gruneisen's ratio, γ, was taken as 0·725 in agreement with the data of Ref. 24.

Previous attempts to measure energy gap changes induced by shear strain have included the measurement of reflectance from Ge samples subjected to bending stress.[25] Also, piezo-resistance measurements in uniaxial *stress* on heavily doped germanium specimens give deformation potential determinations on the motion of individual valley minima and the valence band maximum.[26] WORTMAN *et al.*[27] have used GOROFF and KLEINMAN's[3] theoretical predictions for silicon to predict the effect of various stress tensors on the band structure of germanium and thus the effect upon the characteristics of Ge *p–n* junctions. IMAI and UCHIDA[28] find this analysis to be consistent with their measurements of the characteristics of heavily doped Ge *p–n* junctions under uniaxial *stress*. Similarly, RINDNER[23] has applied uniaxial *stress* to Ge *p–n* junctions and found agreement in sign and qualitative behavior to that predicted by Wortman *et al.*

The effect of *pressure* on the resistivity of Ge has been extensively investigated and recently summarized in the excellent review by PAUL and WARSCHAUER.[29] The energy gap, E_g, is found to increase linearly with *pressure* to 15 kb at a rate of 5×10^{-3} eV kb^{-1}. From 15 kb to 30 kb the rate of increase of E_g decreases significantly. This has been shown to be consistent with the hypothesis that the minimum energy of the conduction band is shifted in k space. Further, effective mass changes of electrons with *pressure* are found to be only $\frac{1}{2}$% per kb, and the mobility of electrons is found to decrease only 0·4% per kb in the absence of intervalley scattering. Considerable correlation is found between the *pressure* dependence of any