

density Ge no such change occurs as the  $P dV$  energy obtained upon compression is probably far less due to the initial high density.

The structural features of the high-density non-crystalline Ge are not yet known.

Two other possible sources of a high-density non-crystalline Ge exist. Firstly the metallic form thought to exist between 60 and 100 kbar [2,3]. Resistivity measurements on the present material confirm that the high-density, non-crystalline Ge is semiconducting and so these two forms are not compatible. Secondly, Ge IV transforms to an amorphous product at ambient conditions. It would be of interest to compare the structural features in the present materials with the aforementioned to obtain an understanding of the mechanism for increasing the density above that of Ge I, and how this is achieved in the sputtering process.

### Acknowledgement

We wish to thank Professor R. Roy for suggesting this study on non-crystalline Ge. The authors would also like to thank R. Messier and L.R. Gilbert for preparing the non-crystalline Ge used in the present work and for all density and resistivity determinations. This work was carried out under Contract NSF-MRL 6478, and under the auspices of JSPS Grant 4R023 and NSF Grant 01P74-2195B.

### References

- [1] D.L. Camphausen, G.A.N. Connell and W. Paul, *J. Non-Crystalline Solids* 8-10 (1972) 223.
- [2] K. Tamura, J. Fukushima, H. Endo, S. Minomura, O. Shimomura and K. Asaumi, *J. Phys. Soc. Japan* 36 (1974) 558.
- [3] O. Shimomura, S. Minomura, N. Sakai, K. Asaumi, K. Tamura, J. Fukushima and H. Endo, *Phil. Mag.* 29 (1974) 547.
- [4] S. Minomura and H.G. Drickamer, *J. Phys. Chem. Solids* 23 (1962) 451.
- [5] K. Asaumi, O. Shimomura and S. Minomura, *Proc. 4th Int. Conf. on High Pressure* (1974) Kyoto, p. 311.
- [6] C.T. Wu and H.L. Luo, *J. Non-Crystalline Solids* 18 (1975) 21.
- [7] C.H. Bates, F. Datchile and R. Roy, *Science* 147 (1965) 860.
- [8] C.H. Bates, Ph.D. thesis, The Pennsylvania State University (1966).
- [9] C.W.F.T. Pistorius in *Progress in solid state chemistry Vol. II* (Pergamon Press, Oxford and New York, to be published).
- [10] W. Klement, Jr. and A. Jayaraman in *Progress in solid state chemistry Vol. 13* (Pergamon Press, Oxford and New York, 1966).
- [11] M.B. Myers, F. Datchile and R. Roy, *Rev. Sci. Instrum.* 34 (1963) 401.
- [12] J.C. Jamieson, *Science* 139 (1963) 762.