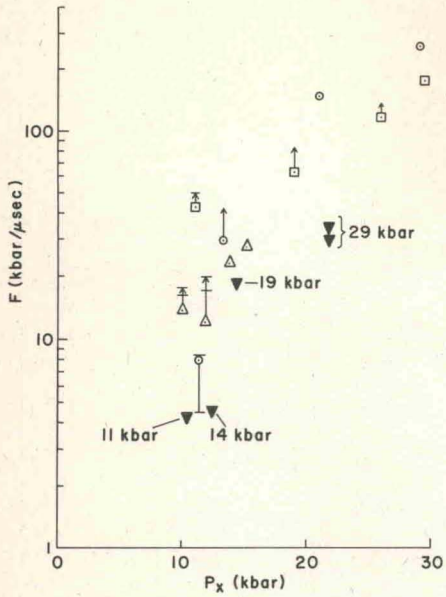


FIG. 5. Relaxation functions derived from precursor decay in LiF. ⊡, ⊙, ◬—from Ref. 9. ▼—new results; pressures indicate elastic impact amplitude.

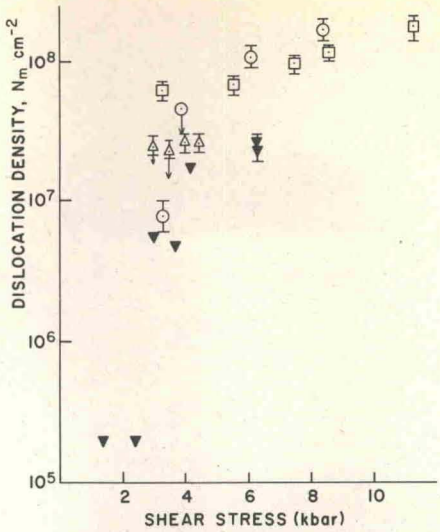


FIG. 6. Dislocation densities derived from precursor decay in LiF. ⊡, ⊙, ◬—from Ref. 9. ▼—new results.

just detectable, $N_m$ exceeds $N_0$ (Table II) by about 20 times, which exceeds possible errors in $N_m$.

Values of relaxation function $F$ and dislocation density $N_m$ for both these and Gupta's measurements[9] are plotted in Figs. 5 and 6. The values reported here for impact pressures of 11.2, 13.8, and 19.1 kbar fit well with Gupta's results; the 28.6-kbar points are significantly lower, corresponding to large values of the precursor amplitude.

## IV. DISCUSSION

Experiments reported here show more clearly than previous work the existence of a threshold for precursor decay in lithium fluoride and the inability of grown-in dislocations to explain rapid precursor decays observed in these and earlier experiments. The 8-kbar shot (75-054) illustrates the thesis suggested by Johnson and Rohde in their study of twinning[16]: no deformation mechanism which depends on plastic strain following the precursor can contribute to precursor decay. Elastic behavior recorded in shot 75-050 shows that even when rise time is very long, regenerative multiplication in the elastic shock front is insufficient to significantly modify precursor decay.

Failure of shots 75-036 and 75-040 to reproduce the nominally equivalent shot in Ref. 7 is disturbing. The difference might be due to surface preparation, but it seems more likely that it results from larger magnesium concentration. It might also be due to the presence of other impurities whose effects have been disregarded. This sensitivity of dislocation processes to small changes in impurity content was presaged by Asay *et al.*[3] If such sensitivities exist in other materials, serious questions must be raised about the validity of inferences drawn about dislocation behavior from mechanical measurements on material in which impurities are but poorly known.

Control and measurement of material impurities certainly represent the greatest barriers to good analytical experiments of the kind attempted here and in earlier related work. In the particular case of magnesium-doped lithium fluoride, yield stress of air-quenched material may be the best indicator of concentration, but the amount of work done on this to date is not enough to provide great assurance of its reliability.

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[1]J.N. Johnson, O.E. Jones, and T.E. Michaels, J. Appl. Phys. **41**, 2330 (1970).
[2]J.N. Johnson and L.M. Barker, J. Appl. Phys. **40**, 4321 (1969).
[3]J.R. Asay, G.R. Fowles, G.E. Duvall, M.H. Miles, and R.F. Tinder, J. Appl. Phys. **43**, 2132 (1972).
[4]O.E. Jones and J.D. Mote, J. Appl. Phys. **40**, 4920 (1969).
[5]J.R. Asay, Ph.D. thesis (Washington State University, 1971) (unpublished).
[6]P.P. Gillis, K.G. Hoge, and R.J. Wasley, J. Appl. Phys. **42**, 2145 (1971).
[7]Y.M. Gupta, G.E. Duvall, and G.R. Fowles, J. Appl. Phys. **46**, 532 (1975).
[8]J.J. Gilman, J. Appl. Phys. **36**, 2772 (1965).
[9]Y.M. Gupta, J. Appl. Phys. **46**, 3395 (1975).
[10]Y.M. Gupta and G.R. Fowles, in *Metallurgical Effects at High Strain Rates*, edited by R.W. Rohde, B.M. Butcher, J.R. Holland, and C.H. Karnes (Plenum, New York, 1973).
[11]G.A. Jones and W.J. Halpin, Rev. Sci. Instrum. **39**, 258 (1968).
[12]D.B. Hayes and Y.M. Gupta, Rev. Sci. Instrum. **45**, 1554 (1974).
[13]R.A. Graham, J. Appl. Phys. **46**, 1901 (1975).
[14]G.W. Swan, G.E. Duvall, and C.K. Thornhill, J. Mech. Phys. Solids **21**, 215 (1973).
[15]J.E. Flinn, G.E. Duvall, G.R. Fowles, and R.F. Tinder, J. Appl. Phys. **46**, 3752 (1975).
[16]J.N. Johnson and R.W. Rohde, J. Appl. Phys. **42**, 4171 (1971).