restricted to shock fronts. However, determination of the extent to which the same threshold values for stress and field are applicable requires a more general analysis of the electric fields in a piezoelectric disk subjected to a stress pulse of arbitrary shape. The development of this analysis is in progress.

VI. CONCLUSIONS

The conclusions of the present work are:

(i) "Anomalous" current-time wave shapes observed from x-cut quartz after stress unloading in short-duration loading experiments are a result of shock-induced conductivity in the unloaded region of the quartz disk.

(ii) Shock-induced conductivity requires a threshold unloading stress of (11.2 ± 0.7) kbar as well as a threshold electric field of $(2.8 \pm 0.3) \times 10^5$ V/cm.

(iii) The threshold electric field for conductivity is found to be independent of stress amplitude for stress amplitudes greater than the threshold value.

(iv) Shock-induced conductivity is triggered by a source of electrons immediately behind shock fronts whose stress amplitudes exceed the threshold value.

(v) The electrons appear to result from strain-induced ionization accompanying transient dislocation motion in the shock front.

(vi) It appears that the electric field acts to accelerate these source electrons to high energies which causes impact ionization and electron cascades.

(vii) The "short-pulse anomaly" observed with $+x$ orientation disks and the "$-x$ anomaly" observed in $-x$ orientation disks are basically the same phenomenon requiring electric fields of the proper polarity; in the former situation the unloading front acts as a source of electrons, while in the latter situation the loading front acts as a source of electrons.

(viii) Finally, the unloading stress front in x-cut quartz shows no evidence for dispersion in the stress range from 0 to 25 kbar.

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APPENDIX

Equations will be derived for the current from x-cut quartz disks subjected to short-duration shock loading while experiencing a low resistivity value through the unloaded stress region.

The general configuration is as shown in Fig. 8. The conditions are the same as in the main body of the text, except that region 3 is conductive. With the same electrostatic relations utilized in the text,

$$E_1 l_1 + E_2 l_2 = 0; \tag{A1}$$

hence,

$$E_2 = -E_1 (t_0 - t)/T_0 . \tag{A2}$$

Applying Eq. (5), it follows that

$$\epsilon E_1 = P + \epsilon E_2 , \tag{A3}$$

which, when combined with Eq. (A2), gives the result that

$$E_1 = (P/\epsilon)\,[T_0/(T_0 + t_0 - t)], \quad t > T_0 . \tag{A4}$$

Solving for the current from the relation

$$i = A \frac{dD}{dt} , \tag{A5}$$

we find that

$$i = PAT_0 (T_0 + t_0 - t)^{-2}, \quad t > T_0 < t_0 . \tag{A6}$$

Note that when $t = T_0$, $i_{T_0} = PAT_0/t_0^2$, and when $t = t_0$, $i = PA/T_0$. For the highest field and stress achieved in the experiments, current-time responses described by (A6) were observed. These solutions are similar to those obtained for the three-zone model of shock-loaded quartz.[4]

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