initial response of a mass element is elastic, (2) the total strain separates into an elastic and a plastic contribution, (3) the plastic dilation is zero, and (4) the elastic precursor is a strict discontinuity in the shock variables. Isentropic flow is also assumed.

In the following derivation, generalized stress components and total strain components will be referred to as S_{ij} and T_{ij}, respectively. In agreement with Eqs. (2.1) - (2.4), principal values are referred to as P_x, ε_x, etc. From assumption (2), we can write the total strain-rate tensor as

$$\dot{T}_{ij} = \dot{E}_{ij} + \dot{P}_{ij} \quad ,$$

where the dots imply time differentiation at a mass element (the convective derivative defined earlier) and where $\dot{E}$ and $\dot{P}$ denote elastic and plastic strain-rate tensors, respectively. An additional assumption is that the elastic part of the strain is related incrementally to stress by Hooke's law; this is written as

$$dS_{ij} = C^{s}_{ijk\ell} dE_{k\ell} \quad , \qquad (2.10)$$

where the S_{ij} are components of the stress tensor and the $C^{s}_{ijk\ell}$ are second-order elastic isentropic stiffness coefficients. The Einstein summation convention is used in Eq. (2.10) and in the following.

Following Johnson *et al.*,[14] two different coordinate systems are defined. One is denoted by $h_i (i=1,2,3)$ and coincides with the crystallographic axes at a mass element. The other is represented by ${}^{\alpha}h'_i (i=1,2,3)$ and is fixed by the various slip systems (denoted by α) in the crystal. For wave propagation along one of the crystallographic directions, as in the present experiments, the stress and strain components in Eq. (2.10) are chosen with respect to crystal axes. This simplifies the mathematical treatment since the elasticity tensor is also referred to cartesian coordinates defined by the crystal axes, and these are the principal axes of stress and strain for plane propagation along a <100> direction. The axes which represent the slip planes in LiF are labeled so that ${}^{\alpha}h'_3$ is normal to the glide plane of a particular dislocation and ${}^{\alpha}h'_1$ is parallel to its Burgers vector.

In LiF, there are six {110}<110> slip systems. In the following, each of these is distinguished by a pre-superscript $\alpha(\alpha=1,\ldots,6)$. The two sets of axes defined here are illustrated in Fig. 2.1 for one of the slip planes in LiF. The coordinate axes shown there are related by

$${}^{1}h'_i = {}^{1}a_{ij}h_j \quad ,$$

where the ${}^{1}a_{ij}$ are coefficients of the transformation matrix defined by

$${}^{1}A = \frac{1}{\sqrt{2}}\begin{bmatrix} -1 & 0 & 1 \\ 0 & -\sqrt{2} & 0 \\ 1 & 0 & 1 \end{bmatrix} \tag{2.11}$$

From Eq. (2.10), Hooke's law can be written in terms of the strain-rate tensors as

$$\dot{S}_{ij} = C^s_{ijk\ell}[\dot{T}_{k\ell} - \dot{P}_{k\ell}] \quad . \tag{2.12}$$

Although this equation strictly applies to equilibrium processes at a mass element, it is shown in Appendix I that it is a good approximation for elastic-plastic deformation. For longitudinal wave propagation along a <100> direction, uniaxial strain implies that $T_{22} = T_{33} = 0$. For this case, Eq. (2.12) simplifies to

$$\dot{S}_{ij} = C^s_{ij11}\dot{T}_{11} - C^s_{ijk\ell}\dot{P}_{k\ell}.$$