elasto-optical constants of diamond, the absolute intensity of scattering by the sound waves of thermal origin in diamond. It comes out to be of the same order of magnitude as that actually observed in these experiments, though an exact quantitative test of the theoretical formulæ is as yet lacking. It will be noticed that at all the temperatures actually employed, the Doppler-shifted components are much less intense than the Raman line arising from the principal lattice vibration.

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X-Ray Spectra of Trans-Uranic Elements

IN view of the recent discovery of elements with atomic numbers 93–96, it is of interest to recall a calculation based on the assumption of a minimum proper length for the world-line of an electron[1]. The conception that it is impossible to discriminate in space-time between two positions of the electron when the interval separating them is less than h/m_0c (m_0 = rest mass) leads to the result that an electron in a Bohr orbit cannot have a velocity greater than $c/\sqrt{2}$. A further consequence of this is that a K-ring cannot exist in an atom for which $Z > hc/2\sqrt{2}\pi e^2$; and this means that the Bohr–Rutherford model would stop at $Z = 96$. Although the original argument leading to this result cannot be regarded as free from objection in the light of modern quantum theory, the likelihood of some such limitation remains. A more recent application of the principle of minimum length and time to the Rutherford–Bohr atom sets the upper limit to Z somewhat lower than 96[2].

According to a theory of the structure of the nucleus[3], a limit to Z occurs in the form $Z^2/A < 47 \cdot 8$, a result which suggests that this limit may actually be set by $Z^2/A < hc/4\sqrt{2}\pi e^2 = 48 \cdot 44$. From this, at any rate, it appears likely that nuclei occur with Z values higher than 96, and from what is known of the artificial production of trans-uranic elements it may be anticipated that such nuclei will be produced. Their life, however, may be short owing to the probability of spontaneous fission increasing rapidly with Z^2/A[4].

In view of what has been said above regarding possible anomalies in the K-rings of such atoms, it will be of interest to examine, if possible, the K and L radiations in their X-ray spectra in order to ascertain if the Moseley sequence of X-ray spectral lines shows a break at an element close to 96.

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A New Criterion of Yielding in Metals

SEVERAL theoretical criteria of yielding have been proposed[1,2] and tested by comparing the stress values found experimentally just as yielding began under simple stress systems. For example, the ratio of simple shear yield stress to simple tensile yield stress T_0/S_0 is given variously by older theories as 1, 0·77, 0·50, 0·62, while experimentally for common engineering materials this ratio is found to be 0·56 approximately. A better fit to experiment is the theory credited jointly to Huber, von Mises and Hencky (ref. 1, p. 478), which for the above ratio gives $1/\sqrt{3} = 0 \cdot 577$. This theory stated in Hencky's form for the stress system S_{ii}, etc., when $i = 1, 2, 3$, $j = 2, 3, 1$, is

$$\Sigma[(S_{ii} - S_{jj})^2 + 6\, S_{ij}^2] = 2\, S_0^2$$

just as yielding is beginning. If the system of stresses is two-dimensional simple shear together with simple tension, then the Huber criterion gives an ellipse by plotting shear stress as ordinate and simple tension as abscissa. Experimental examination[3,4] shows the experimental values to lie approximately on the theoretical ellipse.

The Huber expression is not convenient analytically because it is not linear in the stresses. I noted this in my theory of post-yield stress-strain[5], but have only recently looked for another criterion that would have a linear form in the stresses. The form that follows came from reasoning that was stimulated by a new theory of large strains[6]. However, in this present communication I will merely show arbitrarily that a linear expression can fit the experimental evidence already quoted.

It is found that $T_0/S_0 = 1/[\sqrt{2}(1+q)] = 0 \cdot 56$ when Poisson's ratio, q, is 0·26, and departs slightly from this value as q varies from metal to metal. This value coincides with the experimental value quoted for common engineering metals.

Now consider the ellipse of stress. For any general point stated in terms of the radial vector **a** and the vector stresses **S**, **T**,

$$(\mathbf{T} + \mathbf{S}) = \mathbf{a} \cdot \left[\frac{\mathbf{mm}}{\sqrt{2}(1+q)} + \mathbf{nn}\right] S_0,$$

where the dot indicates the scalar product of the unit vectors **a**, **m**, **n**. This defines the ellipse and reduces to the correct values for S_0, T_0, and hence satisfies the experimental values due to Taylor. Note that in Taylor's tests under simple tension and torsion the level surfaces of vector displacement[3] were planes normal to the longitudinal axis (that is, normal to **n** of the thin tubes used). However, in the general strained body, curved level surfaces of vector displacement are defined. In the simple experimental system or in the more general complex stress systems, the vector $\mathbf{A} = (\mathbf{S} + \mathbf{T})$ is the resultant stress on the face of an orthogonal element with that face in the level surface of vector displacement. In general, the element can be oriented so that **T** has no component normal to the plane of **m** and **n**.

Note that the discussion has been for the simple tensile yield stress S_0, using the first and fourth quadrants of the diagram. Equally well S_0 could be the compression yield, and then one would use the second and third quadrants of the diagram. This may be necessary, for example, with metals having a lower yield stress under compression than they have under tension.

The above linear expression in **S**, **T**, S_0 is suggested as a new criterion of yielding in the general complex