APPENDIX

EDITOR'S NOTES ON CRYSTAL PHYSICS TERMINOLOGY

One of the prime objectives of these symposia is to digest the "state of the art" of materials science for all who are concerned with materials. The contributors being experts in their fields, have used certain terms and conventions which though common in crystal physics, may not be generally understood. So to give an assist to specialists in fields other than crystal physics, we note below a few items on crystal structure and terminology.

Convention for Designating Crystal Faces and Directions—Miller Indices:[1,2]

As crystals by their nature are anisotropic, it is necessary when discussing properties to designate the direction and plane or planes to which the value of the property applies. A workable symbolism for orientation of a plane in a lattice is embodied in the Miller indices, which are defined as the reciprocals of the fractional intercepts which the plane makes with the crystallographic axes. As reciprocals are used, the designation for a plane parallel to an axis is zero instead of infinity.

A particular plane may be designated as, say, (110) which intersects two axes positively and is parallel to the third. If an intercept is negative, a bar is placed over the number for that intercept. Directions are represented by enclosing the reciprocal intercept in brackets [*abc*]. Families of planes representing symmetry are designated with angular brackets ⟨*abc*⟩ and planes bounded by perfect crystal faces are designed {*abc*}.

[1] George L. Clark, "Applied X-rays," McGraw Hill Book Co., New York, N. Y., pp. 233–236 (1940).

[2] B. D. Cullity, "Elements of X-ray Diffraction," Addison-Wesley Publishing Co., pp. 37–41 (1956).

Elastic Constants of Crystals—Hooke's Generalized Law:[3]

The six equations of Hooke's generalized law of crystal elasticity are:

$$\sigma_x = c_{11}\epsilon_x + c_{12}\epsilon_y + c_{13}\epsilon_z + c_{14}\gamma_{yz} + c_{15}\gamma_{zx} + c_{16}\gamma_{xy}$$

$$\sigma_y = c_{12}\epsilon_x + c_{22}\epsilon_y + c_{23}\epsilon_z + c_{24}\gamma_{yz} + c_{25}\gamma_{zx} + c_{26}\gamma_{xy}$$

$$\sigma_z = c_{13}\epsilon_x + c_{23}\epsilon_y + c_{33}\epsilon_z + c_{34}\gamma_{yz} + c_{35}\gamma_{zx} + c_{36}\gamma_{xy}$$

$$\tau_{yz} = c_{14}\epsilon_x + c_{24}\epsilon_y + c_{34}\epsilon_z + c_{44}\gamma_{yz} + c_{45}\gamma_{zx} + c_{46}\gamma_{xy}$$

$$\tau_{zx} = c_{15}\epsilon_x + c_{25}\epsilon_y + c_{35}\epsilon_z + c_{45}\gamma_{yz} + c_{55}\gamma_{zx} + c_{56}\gamma_{xy}$$

$$\tau_{xy} = c_{16}\epsilon_x + c_{26}\epsilon_y + c_{36}\epsilon_z + c_{46}\gamma_{yz} + c_{56}\gamma_{zx} + c_{66}\gamma_{xy}$$

where:

$\sigma_x(\sigma_y,\sigma_z)$ = normal stress on x-(y-,z-) axis,
τ_{yz} = shear stress in direction of y and perpendicular to z,
γ_{yz} = displacement in direction of y of two planes of unit distance perpendicular to z, and
ϵ_x = change of spacing of two planes perpendicular to x.

The parameters c_{ik} are designated as moduli. Six corresponding equations may be obtained expressing ϵ_x(y-, z-) and γ_{yz}(zx-, yx-) in terms of σ, τ, and the parameters s_{ik} called coefficients of elasticity.

The equations may be simplified by taking crystal symmetry into account; for example, a regular cubical crystal may be characterized by the six equations with only the three coefficients c_{11}, c_{12} and c_{44}, all the other coefficients being zero.

[3] Schmid and Boas, "Plasticity of Crystals," F. A. Hughes & Co., Ltd., pp. 14–16 (1950)

