Aufgabe 12-1: biaxial stress

The difference between two strains in a stressed specimen depends only on the stress acting in the plane of those strains. One may calculate stress in any chosen direction from plane spacing (with stress-free d_0 spacing) determined from two measurements: when the plane are normal to the specimen surface (with d_n spacing), and when the same plane have an inclined angle of ψ containing the direction of the stress to be measured (with d_i spacing). The stress equation can be approximated as (when unknown spacing d_0 be replaced by spacing d_n):

$$\sigma_\phi = \frac{E}{(1+\nu)sin^2\psi}(\frac{d_i - d_n}{d_n})$$

where σ_ϕ is the stress in any chosen direction, E is *Modulus of Elasticity*, and ν is *passion's* ratio.

A uniaxial tensile stress of 100 ksi is being measured in iron by reflecting X-rays from the (211) planes at $\psi = 0$ and 45°. Take the lattice parameter a of the stress-free iron to be 2.8665 Å, E=30 $\times 10^6$ psi, and $\nu = 0.29$.

(a) Calculate d_0, d_n, and d_i to five significant figures.

(b) What percent error is made in replacing $\frac{d_i - d_n}{d_0}$ by $\frac{d_i - d_n}{d_n}$ in stress equation?

Aufgabe 12-2: residual stress (measurement of diffraction line position)

For calculation of the residual stress, when the diffraction lines are broad, certain corrections should be applied to the intensity data before finding the line center. Measured intensities are to be divided by LPA in order to make the lines more nearly symmetrical, before determining the line center by the least-squares or three-point method.

LPA = (modified Lorentz-polarization (L-P) factor) (absorption factor) =

$$(\frac{1 + cos^2 2\theta}{sin^2\theta})(1 - tan\psi \; cot\theta)$$

The circumferential (hoop) stress in a cylinder of 1045 steel, due to water quenching followed by glass bead peening, is measured with diffractometer (Cr kα radiation, 211 reflection). The lien shift $\Delta 2\theta$ when a stress-free specimen is rotated from $\psi = 0$ to $\psi = 45°$ is -0.1°. Take the stress constant k_1 as 90 ksi/deg. The time *t* given below is the time required to accumulate 20,000 counts at each angle.

ψ	2θ	t(sec)
	155.00°	69.20
0	155.80	54.47
	156.60	71.64
	156.00	35.84
45°	156.50	32.35
	157.00	33.83

(a) Calculate the residual stress by determining the line center using three-point method and without correction for line asymmetry. Stress equation can be considered as:

$$\sigma_\phi = k_1(2\theta_n - 2\theta_i) = k_1 \Delta 2\theta$$

where $\Delta 2\theta = 2\theta_n - 2\theta_i$ the shift in diffraction line position due to stress as the angle ψ is changed.

(b) Calculate the residual stress with correction for line asymmetry by the LPA factor.
(1ksi = 1000 psi = 6.895 MPa)

(c) The breath of an x-ray diffraction line often correlates well with the hardness of the specimen; estimate the hardness of this specimen.