Answer on Question#57182 - Physics - Solid State Physics

The young's modulus for steal is $E = 2 * 10^{11} \frac{\mathrm{N}}{\mathrm{m}^2}$. If the inter atomic spacing for the metal is $a = 2.8$ angstrom. Find the increase in the inter atomic spacing Δa for a force of $\sigma = 10^9 \frac{\mathrm{N}}{\mathrm{m}^2}$, and the force constant k?

Solution:

It's known that

$$\sigma = E \cdot \frac{\Delta a}{a}$$

Thus

$$\Delta a = a\frac{\sigma}{E} = 2.8\ \text{Å}\frac{10^9 \frac{\mathrm{N}}{\mathrm{m}^2}}{2 * 10^{11} \frac{\mathrm{N}}{\mathrm{m}^2}} = 0.014\ \text{Å}$$

Force constant:

$$k = \frac{E}{a} \cdot 1\ \mathrm{m}^2 = \frac{2 * 10^{11} \frac{\mathrm{N}}{\mathrm{m}^2}}{2.8\ \text{Å}} \cdot 1\ \mathrm{m}^2 = 7.14 \times 10^{20} \frac{\mathrm{N}}{\mathrm{m}}$$

Answer: $\Delta a = 0.014$ Å, $k = 7.14 \times 10^{20} \frac{\mathrm{N}}{\mathrm{m}}$.