

$$E = \frac{\sigma}{\epsilon} = \frac{F/A}{\Delta L/L}$$

$$\Delta L = \text{Force} \cdot \text{Length} / \text{Modulus} \cdot \text{Cross-sectional area}$$

$$Q = 4 \text{ GPa} = 4 \cdot 10^9 \text{ Pa}$$

$$F = 100 \text{ pN} = 100 \cdot 10^{-12} \text{ N}$$

$$L = 8 \text{ nm} = 8 \cdot 10^{-9} \text{ m}$$

$$r = 4 \text{ nm} = 4 \cdot 10^{-9} \text{ m}$$

$$A = \pi \cdot r^2$$

$$A = \pi \cdot (4 \cdot 10^{-9} \text{ m})^2 = \pi \cdot 16 \cdot 10^{-18} \text{ m}^2$$

$$\Delta L = F \cdot L / \text{Modulus} \cdot \text{Cross-sectional area}$$

$$= 100 \cdot 10^{-12} \text{ N} \cdot 8 \cdot 10^{-9} \text{ m} / 4 \cdot 10^9 \text{ Pa} \cdot \pi \cdot 16 \cdot 10^{-18} \text{ m}^2$$

$$= 800 \cdot 10^{-21} / 64 \cdot 10^{-9} \pi$$

$$= 12.5 \cdot 10^{-12} \text{ m}$$

$$= 1.25 \text{ nm}$$

$$\text{Length } A = (4 \cdot 10^8) / (660 \cdot 3)$$

$$\text{Length } A = (4 \cdot 10^8) / (1980)$$

$$\text{Length } A \approx 202020.2 \text{ \AA}$$

$$\approx 10000$$

$$\text{Length } A \approx 202020.2 \text{ \AA} / 10000$$

$$\text{Length } A \approx 20.2 \text{ \mu m}$$

$$= 19.6 \text{ Mm}$$

