3.22 Mechanical Properties of Materials
Spring 2008

Group: Effects of multidimensional defects on III-V semiconductor mechanics
PS2 part b work detailing calculations of Young's modulus

We use the following equation to solve for Young's modulus in the different directions:

$$\frac{1}{E_{[hkl]}} = S_{11} - 2[(S_{11} - S_{12}) - \frac{1}{2}S_{44}][\alpha^2\beta^2 + \alpha^2\gamma^2 + \beta^2\gamma^2]$$

From the review article we see that

$$E_{<100>} = \frac{1}{S_{11}} = 8.547\text{x}10^{10}\text{Pa}$$

and using $\alpha = \beta = \gamma = \frac{1}{\sqrt{3}}$

$$E_{<111>} = 1.422\text{x}10^{11}\text{Pa}$$

for $\alpha = \beta = \frac{1}{\sqrt{2}}$ in the $< 110 >$ direction

$$E_{<110>} = 1.22\text{x}10^{11}\text{Pa}$$

We conclude that the $< 111 >$ direction is the direction with the highest Young's modulus, hence it will be more resistant to stretching in the direction.