

5.14

$$E_{ep} = E_{al}$$

$$\frac{\epsilon_p}{A_{al}}$$

$$\frac{1}{E_{ep}} (\sigma_1 - \nu \sigma_2) + \alpha_p \Delta T = \alpha_{al} \Delta T$$

$$\sigma_1 = \sigma_2 = \sigma \rightarrow \sigma = \frac{E_{ep} (\alpha_{al} - \alpha_{vp}) \Delta T}{1 - \nu_{vp}}$$

$$= \frac{(3.2e6)(2.5 - 5) 10^{-5} (-160)}{1 - 0.35} = 19.7e6 \text{ Pa}$$

$$K_{Ic} = \frac{1}{\sigma} \sqrt{\pi a} \rightarrow a = \frac{\pi K_{Ic}^2}{4\sigma^2}$$

plane strain: $K_{Ic}^2 = \frac{E G_c}{1 - \nu^2}$

$$a = \frac{\pi}{4\sigma^2} \cdot \frac{E G_c}{1 - \nu^2} = \frac{\pi}{4 (19.7e6)^2} \cdot \frac{(3.2e9)(120)}{(1 - 0.35^2)}$$

$$= 0.886 \text{ mm}$$