

MAJOR

Elements of Materials Processing (PYL116)

Time: 2 hrs

01 May, 2017 (3:30 PM)

Max. Marks: 40

1. (a) What do you understand by the terms 'electronic energy loss' and 'nuclear energy loss'? Explain them. (b) Sketch a graph depicting the variation of these energy losses with the energy of a projectile atom in the entire energy range. (3+2)

2. (a) Write down the equations for the Fick's first law and the Fick's second law. (b) What are the two main diffusion mechanisms through which the atoms diffuse in a crystalline solid. (2+3)

$$\alpha_{\text{GaN}} > \alpha_{\text{Si}}$$

3. (a) If GaN epilayer is grown over silicon(111) wafer using MOCVD technique, then what kind of stress will be generated within the grown layer? If initially the silicon wafer is flat, then how it will appear after the growth of the GaN layer? Draw schematically the shape of the wafer. (b) Explain briefly how Raman spectroscopy can be used to determine the stress in a crystalline thin film deposited on a substrate? (3+2)

4. (a) What do understand by the terms 'selectivity' and 'anisotropy' in the context of etching of thin films? (b) What is 'reactive ion etching (RIE)'? Explain why the RIE process for semiconductors is anisotropic in nature? (3+3)

5. (a) Draw the schematic of a DC sputtering system. (b) What is Paschen's law? Show it in the graphical form and explain the dependence of V_B on $P \cdot d$. (3+3)

6. Explain the ion-cut process for achieving layer transfer in semiconductors. (3)

$$V_B = \frac{A(Pd)}{A(Pd) + d}$$