Indian Institute of Technology, Delhi

Fundamentals of Dielectrics and Semiconductors (PYL201/epl213)

MAJOR, Nov 2016
Max. marks 40

5A

1. A conduction band electron in Si(100) occupy in k space $(2\pi/a)*(0.85,0.2,0.2)$. Estimate the energy level, measured from the conduction band edge. ... 3 marks

2. Explain briefly semiconductor bandgap engineering (min of 4 ways).. 4 marks

3. Explain the terms (1) *dielectric anisotropy* , (2) *piezoelectric anisotropy* (with relevant expressions and diagrams)... 3x2 =6 marks

4. Find the required minimum dopant concentration at which the doped silicon becomes a degenerate semiconductor at room temperature. (for Silicon , E_g=1.12eV; m_0= $9.1\cdot10^{-31}$ kg, $\hbar = 1.05.10^{-34}$J-s; $m_e^*=1.18m_0$; $m_h^*=0.81m_0$; k_b= $8.617.10^{-5}$ eVK^{-1}) ...4 marks

5. What is complex refractive index in typical isotropic material and show that how this material quantity influences the light propagation in a medium? .....3 marks

6. Silicon ingot is doped with 10^{16} at/cm^3 Arsenic atoms. Find the carrier concentrations and Fermi energy level at 300K. Show these results in schematic energy band diagram. (for Si, E_g= 1.12eV, n_i= $9.6x10^9$ cm^{-3})..... 5 marks

7. Show that in the process of light absorption, the cross-over energy between the direct band edge to the Urbach tails is temperature sensitive. ... 5 marks

8. (a) Why does the potential barrier vary (with respect to zero bias) in forward/reverse biased *pn* junction. (b) Derive expression for current density with respect to bias voltage in pn junction. (c) Explain why forward bias current-voltage characteristics show different ideality factors. ... 3+4+3=10 marks