國立中正大學103學年度碩士班招生考試試題

系所別：光機電整合工程研究所　　科目：材料科學與工程導論

第2節　　

1. Lithium (Li) has a body-centered cubic (BCC) crystal structure. The atomic radius of Li is 0.152 nm.
   (a) Determine the lattice constant of Lithium. (7 %)
   (b) Determine the interplanar spacing for the (211) set of planes. (7 %)
   (c) For X-ray diffraction (XRD) on crystalline lithium powder specimen, determine the expected diffraction angle 2θ for the first order (n=1) diffraction from the (211) set of planes. The wavelength of the X-ray is 0.1542 nm. (7 %)
   (d) List the Miller indices of the first four peaks of XRD for lithium. (4 %)

2. (a) Determine the atomic packing factor (APF) for face-centered-cubic (FCC) structure. (6 %)
   (b) The atomic packing factors (APF) for FCC and for hexagonal closed-packed (HCP) structure have the same value, explain why. (5%)
   (c) Write out the Miller indices (or Miller-Bravais indices) of the close-packed plane of FCC and HCP, respectively. (6%)
   (d) Draw to show an edge dislocation and a screw dislocation. Indicate the (i) dislocation line, (ii) Burgers vector, (iii) direction of dislocation motion. (8%)

3. A plate of iron is exposed to a carburizing (carbon-rich) atmosphere on one side and a decarburizing (carbon-deficient) atmosphere on the other side at 800 °C. If a condition of steady state is achieved, calculate the diffusion flux of carbon through the plate if the concentrations of carbon at positions of 6 and 12 mm beneath the carburizing surface are 1.4 and 1.0 kg/m^3, respectively. Assume a diffusion coefficient of 5×10^{-11} m^2/s at this temperature. (15%)

4. Consider a *p-n* junction LED, and the band gap energy is 3 eV. Answer the questions below:
   (a) Calculate the emission wavelength of this LED. (15 %)
   (b) Draw the net positively and negatively charged regions in the space charge region. (10%)
   (c) Draw the energy-band diagram of a *p-n* junction in thermal equilibrium. (10%)