

Prof. Rav Kumar

17/11/2023 (2)

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Department of Materials Science and Engineering

End Semester Examination, November, 2023

B.Tech VII Semester

MSD-411 Thin film technology

Time: 3 hours

Total Marks: 50

Note: All the questions are compulsory.

1. Explain the working of penning gauge and pirani gauge. Can we use Penning gauge at normal atmospheric pressure? (5)
2. Why it is important to study directionality of evaporating molecules? What is cosine law and state its importance? (5)
3. What factors influence the sputtering yield? How can the sputtering yield be maximized? (5)
4. What property of materials makes thermal evaporation possible? How can one manipulate this property to deposit thin films of materials? (5)
5. Describe the Pulse laser deposition (PLD) techniques for thin film growth. How PLD enables to maintain stoichiometric transfer from target to substrate. (5)
6. Design a vacuum system, which can operate at the vacuum of  $10^{-7}$  torr. Describe the each component of the system and draw the labeled Figure. (5)
7. Describe the Electroplating and Anodization Processes of thin film coating. Which one of the process is required for depositing the oxides of metals. (5)
8. If a film is illuminated with light whose wavelength in free space is  $\lambda = 600$  nm.
  - a) Calculate the minimum thickness of a soap-bubble film that results in constructive interference in reflected light (2)
  - b) What if the film is twice as thick? Does this situation produce constructive interference? (3)
9. (a) A sample of chromium (Cr) is analyzed by x-ray diffraction using copper  $K_{\alpha}$  radiation for which  $\lambda = 1.5418$  Å. Determine the Miller indices of the plane from which the angle of reflection is  $31.4^{\circ}$ . The lattice constant of Cr,  $a = 2.96$  Å. Report your answer in the form (hkl). (3)  
(b) For BCC iron, compute (a) the interplanar spacing, and (b) the diffraction angle for the (220) set of planes. The lattice parameter for Fe is  $0.2866$  nm ( $2.866$  Å). Also, assume that monochromatic radiation having a wavelength of  $0.1790$  nm ( $1.790$  Å) is used, and the order of reflection is 1. (2)
10. Describe types of thin film growth? What are the similarities between capillary and Atomistic theory? (5)