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**SARDAR PATEL UNIVERSITY**  
**M.Sc. (Physics)(IIIrd Semester) Examination**  
**Date : 07/04/2016, Day : Thursday, Time : 2:30 p.m. to 5:30 p.m.**  
**Subject : Nanoscience and Thin film Physics, Paper No. PS03CPHY02**  
**CBCS(choice based credit system)**

Important Note : Q.1 : Multiple choice questions (MCQ) carries one mark each.  
 Q.2 : Short questions carries two marks each (attempt any seven out of nine)  
 Q.3 to Q.6 : Long questions carries 12 marks .

**Total Marks : 70**

Choose the appropriate options from the following in Q.1

**Q.1**

**(8)**

- i) Scanning near field optical microscopy(SNOM) has resolution of  
 (a) 20nm to 40nm      (b) 100 nm      (c) 100A°      (d) 10A°
- ii) In plasma enhanced CVD, low pressure plasma is used to  
 (a) provide necessary reaction temperature      (b) decompose gas molecules into reactive molecular fragments      (c) support CVD reaction by sputtering      (d) None
- iii) If the film and substrate are of different material it is termed as  
 (a) homoepitaxy      (b) heteroepitaxy      (c) coalescence      (d) pseudoheteroepitaxy
- iv) In capillarity model, to form condensed phase i.e stable aggregates from the supersaturated vapour we require supersaturation  
 (a) less than unity      (b) zero      (c) greater than unity      (d) infinite
- v) What changes during and after coalescence of composite island ?  
 (a) area      (b) inclination angle      (c) thickness      (d) mass
- vi) In thin films the confinement of electrons is in (D:dimension)  
 (a) 3D      (b) 1D      (c) 2D      (d) 0D
- vii) Which of the following technique can be used to monitor in-situ the epitaxial growth of thin films by MBE?  
 (a) AES      (b) LEED      (c) RHEED      (d) SEM
- viii) Which of the following techniques used for thin film characterization has good lateral resolution?  
 (a) RBS      (b) SIMS      (c) AES      (d) XPS

Q.2

Answer any seven questions out of nine in Q.2

(14)

- i) What are metal colloids and how they can be stabilized ?
- ii) State the principle on which Scanning tunneling microscope works.
- iii) Explain the use quadrupole magnet in RBS.
- iv) What is meant by adsorption and desorption in thin film growth?
- v) Considering any suitable reaction equation, discuss the use of controlled chemical reaction for deposition of thin films by basic CVD technique.
- vi) What do you understand by pyrolytic and photolytic processes in LECVD?
- vii) Explain the process of Auger electron generation and describe how depth profiling is made possible with AES.
- viii) How contact and non-contact mode in AFM differs ?
- ix) Define thermal accommodation coefficient and coalescence phenomena.

Q.3(a) Describe construction and working of TEM and explain how bright field image and dark field images are obtained in TEM. (6)

Q.3(b) Describe laser ablation and sol-gel technique used for synthesis of nanostructures. (6)

OR

Q.3(b) Using schematic diagrams explain the working principle of bound state-continuum infrared photodetector. (6)

Q.4(a) Considering the capillarity model obtain the expression for critical nucleus and nucleation rate. (6)

Q.4(b) Discuss how stylus profilometry and quartz crystal monitors(QCTM) can be used to determine the thickness of thin films ? (6)

OR

Q.4(b) Describe four different stages of film growth with appropriate diagrams. (6)

**Q.5(a)** Differentiate between Sputtering and Ion-beam assisted methods of thin film deposition and explain any one of them in detail. (6)

**Q.5(b)** Explain the basic process of physical vapour deposition and discuss the e-beam technique in detail. What are its merits and limitations? (6)

**OR**

**Q.5(b)** What is the role of Radio-Frequency in RF-Sputtering? Explain its use in case of RF-magnetron sputtering method. (6)

**Q.6(a)** What happens when a high energy e-beam strikes a solid surface? Enlist different methods of thin film characterization in each case and explain how it is realized in SEM. (6)

**Q.6(b)** Explain how X-ray photoelectrons are emitted from a specimen under observation by using XPS? Discuss how they are detected to identify the chemical make-up of the specimen. (6)

**OR**

**Q.6(b)** Explain how the secondary ions are produced from the sample for detection of chemical species in it by SIMS. Is depth profiling possible in this method of chemical characterization? (6)

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