

## MNT 503

### Synthesis and Characterization at Nanoscale

**1-**What is quantum size effect? Also, explain what happens the properties of material at nano-scale. Give examples.

**2-**What is the difference between nanostructures and nanomaterials? Classify the nanomaterials according to their sizes and give at least three examples for each group.

**3-**Answer the followings about carbon nanostructures;

-Write down the common carbon nanostructures scientifically and industrially important.

-Draw their structures at atomic scale and discuss their electrical, thermal and optical properties.

-Which production method yields the cleanest and defect free graphene? Why?

**4-**What is sculptured film and why do we need to produce it? Explain in detail the production technique and the common types of materials used in those films.

**5-** How aerogels are produced? And what is the underlying reason for classification of them as nanostructured material?

**6-** (a) How electrical and optical properties of quantum dots can be tuned? Explain using energy-band diagrams and quantum confinement effect.

(b) Write down at least three application areas of quantum dots.

**7-**What is the difference between nanowires, nanorods and nanopillars? Is it possible to use nanowires in biological sensor? Why?

**8-**What are the advantageous points in production of nanocomposites? And what kind of reinforcements can be used?

**9-**Write down at least one production method for bottom-up and top-down approaches.

**10-**Explain the followings about coating methods:

(a)What is the difference between thermal evaporation and sputtering in terms of working principle of the device?

(b) Explain in which situation you prefer to use molecular beam epitaxy (MBE). What is the difference between MBE and sputtering?

**11-**What is the difference between Physical Vapor Deposition (PVD) and Chemical Vapor Deposition (CVD)? Explain the production of graphene by CVD.

**12-**What is a semiconductor chip? How is it produced by photolithography? Explain common processing steps.

**13-**When do you prefer acidic or basic conditions in sol-gel process? Discuss also the effect of increasing acidic and basic conditions on gel network.

**14-**What are common methods used for obtaining self-assembly structures? Is there any difference between self-assembly and layer by layer assembly? Briefly explain.

**15-**What kind of imaging techniques can you use for characterization of nanomaterials? In which conditions SEM and TEM is used? Also, briefly explain the working principles of both devices.

**16-**Compare and contrast AFM and SPM in terms of working principle and capabilities.

**17-**Can you use both FTIR and XPS for molecular identification? Why or why not?