Question Paper

Exam Date & Time: 28-Nov-2022 (09:00 AM - 12:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VII Semester End Semester Examination
Introduction to Biomedical Nanotechnology (BME 4053)

Introduction to Biomedical Nanotechnology [BME 4053]

Marks: 50 **Duration: 180 mins.**

Descriptive Questions

Answer all the questions. Section Duration: 180 mins

1) Mr. Y is preparing ZnO nanoparticles using Zinc nitrate and NaOH as reactants. Explain multiple steps in the formation of ZnO nanoparticles based on La Mer's mechanism? (3)

A)

B) Ms. X have prepared 3 samples of Quantum dots. (2)

Sample details are given below:

Sample 1 :- contains Quantum dots with diameter 2 nm
Sample 2 :- contains Quantum dots with diameter 5 nm
Sample 3 :- contains Quantum dots with diameter 10 nm

An UV Visible spectroscopy study showed optical absorption related to valance band to conduction band at the wavelength of 300nm, 280nm and 330nm. Identify the sample which showed the optical absorption of 330nm. Justify your answer with appropriate reasons

C) Ms. X have prepared ZnO nanoparticles using Zinc nitrate and NaOH as reactants. (5)

Sample details are given below:

Sample 1 :- contains ZnO nanoparticles with diameter 2 nm
Sample 2 :- contains ZnO nanoparticles with diameter 5 nm
Sample 3 :- contains ZnO nanoparticles with diameter 10 nm

Which one of these samples will show minimum agglomeration of ZnO nanoparticles? Justify your answer with appropriate reasons.

2) Describe chemical vapor deposition method (CVD) for nanomaterial synthesis (3)

A)

B) Compare precipitation and hydrothermal method for nanomaterial synthesis. (2)

C) Mr. X objective is to prepare ZnO Quantum dots using all the given chemicals. (5)

Available chemicals are:

1. Zinc2-ethylhexanoate (Zn-2EH), which is soluble in non-polar solvents (reactant 1)
2. Sodium hydroxide, which is soluble in polar solvents, (reactant 2).
3. distilled water (polar), cyclohexane (nonpolar) as solvents
4. surfactant.

Suggest a procedure for efficient synthesis of ZnO QDs using all the reagents with justification?

Note: Zinc2-ethylhexanoate and sodium hydroxide will react form ZnO, Details like molarity, weight etc. are not required.

3) Mr. X have prepared zinc oxide nanoparticles (ZnO) and functionalized with oleic acid. (3)

A) Suggest a characterization technique to study the functionalization of oleic acid on the nanoparticle surface.

Justify your suggestion with detailed explanation on the characterization technique.

B) Explain the characterization technique which can be used to measure the hydrodynamic radius of the nanoparticles. (2)

C) Ms. Y have prepared Gold nanoparticles. (5)
She has to study the agglomeration of Gold nanoparticles over time. She does not have the facility to use any imaging methods like SEM TEM or SPM.

Suggest an alternative characterization technique to study the agglomeration of gold nanoparticles after 30 minutes, 2 hours, 10 Hours, 1 day and 2 days of preparation.

Justify your suggestion with detailed explanation on the characterization technique.

4) Mr. X is preparing gold nanorods. Suggest a characterization technique to understand the synthesized nanomaterial is gold nanorods or nanoparticles. Explain the working principle of the characterization technique. (3)

A)

B) A twisted pair of nano Ti wires wrapped around a thicker Ni wire is given for Scanning Electron Microscope (SEM) imaging. Along with secondary electron imaging, back scatter mode image of same specimen is lso taken by the SEM operator. shown in figure b. Explain why the back scatter image is required in this case. (2)

C) Design a nanoparticle system which can be used for photothermal therapy (PTT) and can act as contrast agent for MRI. (5)

5) Develop a strategy to sense acceptor-donor interaction based on FRET (Fluorescence Resonance Energy Transfer) (3)

A)

B) Explain the concept of photodynamic therapy and detail the application of nanotechnology in photodynamic therapy. (2)

C) Design a specific drug delivery system for the intracellular delivery of doxorubicin in a cancer cell. The strategy should be a combination of pH dependent and magnetic drug delivery methods. (5)

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