BHAGINI NIVEDITA COLLEGE, UNIVERSITY OF DELHI

NANOMATERIALS AND APPLICATIONS; (BSC (HONS.) PHYSICS VI SEM)

ASSIGNMENT-01

TIME: 3 DAYS: ON 31 MARCH, 2020 (AT 12:00 A.M.) ALL THE ANSWERS WILL BE DISUCSS IN E-CLASS, DOUBTS CAN BE POSTED TO GROUP IN MEANWHILE AND AN ANSWER SHEET WILL BE PREPARED.

MARKS WILL BE GIVEN ACCORDINGLY (EVERY QUESTION IS OF 3 MARKS)

BE HOME BE SAFE, DON'T GO OUTSIDE, WASH YOUR HANDS PROPERLY, SUPPORT LOCKDOWN, FOLLOW ALL GUILDELINES AND INSTRUCTIONS OF GOVERMENT

SHORT ANSWER TYPE QUESTIONS

1. Give one example each of the structures where an electron feels (i) 1D, (ii) 2D and (iii) 3D confined.
2. Draw a comparative energy band diagram of (i) a bulk crystal, (ii) a nanodot and (iii) an isolated atom. Explain briefly why the spacing between the energy levels is different in each case?
3. Explain the reason why nanostructures of a given material are more chemically reactive than their bulk counterparts?
4. What is the expression of the size dependent energy gap of a spherical semiconductor quantum dot? Explain briefly the various terms in the expression and nature of their dominance.
5. Explain three structural parameters that can be determined about the material from its XRD spectrum?
6. Explain with the help of diagram, what do you understand by direct and indirect bandgap semiconductors?
7. What is the difference between scanning electron microscope (SEM) and transmission electron microscope (TEM)?
8. Draw the curves of density of states for charge carriers as a function of the dimensionality (3D, 2D and 1D) of materials.
9. How many cubes with each side of 1 nm can be carved out from a cube with each side of 1 m? Compare the surface area to volume ratio for both the cases.

10. Differentiate between top-down and bottom-up approach for synthesis of nanostructure materials.
11. The diffraction pattern of copper nanostructure was measured with x-ray radiation of wavelength of 1.315 Å. The first order Bragg diffraction peak and its full width at half maximum (FWHM) is at an angle 2θ of 50.5° and 0.5°, respectively. Estimate the crystallite size of the copper nanostructure.
12. What are quasi particles? Give two examples.
13. Discuss with diagram the confinement direction of electrons in 2D, 1D and 0D materials.
14. Sketch and label a schematic diagram of single electron transfer device.
15. Determine the surface area to volume ratio of spherical particles of radii 1nm, 10 nm, 1μm, and plot the variation of the ratio with diameter.
16. What are Nanomaterials? Explain the classification of nanomaterials with example?
17. Sketch the three modes of thin film growth.
18. Draw the typical XRD curve of a crystalline, polycrystalline and amorphous material.
19. Differentiate between absorption and luminescence processes.
20. Explain deep and surface level defects with a suitable diagram.
21. What is the difference between LED and solar cells?
22. What do you mean by quantum dots? Explain one application of quantum dots.
23. Explain the nucleation and growth of nanoparticles with suitable diagram.
24. Comment whether the synthesized material will be nanomaterial or not using the XRD data: peak positioned at 30 degree with broadening 0.3 performed with x-ray wavelength 0.154 nm.
25. Explain the formation of band structures in nanostructures from molecular approach.
26. Why electrons are used for imaging nanostructures and not photons?
27. What do you mean by quantum dots? Explain one application of quantum dots.
28. Name various signals generated from electron-matter interaction and their use in spectroscopy.
29. An electron of energy 10 eV falls on a rectangular barrier of height 11eV. Using the exact expression, find the probability of transmission if the width of barrier is 0.1 nm.

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