Question Paper

Exam Date & Time: 05-Jan-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

Biomaterial-characterization techniques [BME 4052]

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

Descriptive

Answer all the questions.

1A) The surface energy for different planes of aluminum metal is given in the table below. Predict which two planes are more likely to form the facet of aluminum crystal. Justify your answer. Illustrate the potential shape of the crystal. (4)

Table: Surface energy of different planes of aluminum

Plane	Surface energy (eV/nm2)
001	6.5
110	6.9
111	5.6
210	7.2

1B) Distinguish between the fracture toughness of a material and the hardness of a material. (2)

1C) Compare between phase contrast and differential interference contrast (DIC) microscopy methods. (4)

2A) A compound exists in three different crystal forms A, B, and C. (4)

i, Choose an appropriate method to distinguish between the B from C forms of the compound.
ii, Explain the principle behind the chosen method with illustrations.
iii,Choose an appropriate method to calculate the size of A and explain how you calculate the size of A.

2B) Distinguish between UV-VIS and fluorescence spectroscopy with suitable illustrations. (3)

2C) Elaborate in detail on attenuated total reflection-Fourier Transform infra-red Spectroscopy (ATR-FTIR) technique. (3)

3A) Compare normal phase versus reverse phase mode in liquid chromatography. (4)

3B) Distinguish between isocratic and gradient elution in liquid chromatography. (3)

3C) Elaborate in detail about gas chromatography and explain the types of detectors used in gas chromatography (3)

4A) Apprise the factors that influence the recording of thermogravimetric (TGA) trace of a material. (4)

4B) Distinguish between differential thermal analysis (DTA) and differential scanning calorimetry (DSC). (3)

4C) Compare the types of differential scanning calorimetry (DSC) instrument and their working with suitable illustrations (3)

5A) A quadrupole mass analyzer used in SIMS needs to resolve two ions with small differences in their weight. Propose ways by which the mass analyzer can differentiate between the two ions (3)

5B) Auger electron spectroscopy (AES) requires high vacuum conditions. Appraise the reason why high vacuum is required for AES spectroscopy. (3)

5C) A scientist characterized a surface modified with amine functional group using X-ray photoelectron spectroscopy (XPS). He characterized the surface and found apart from amine groups other (4)

functional groups like OH were present. Examine the possible reason why OH groups were characterized. Propose method by which the scientist can more accurately characterize the surface.

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