

Surface Engineering of Nanomaterials

Week 2: Sample problems



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Q1. Ultrasonic cleaning is a type of _____

- a) Grinding process
- b) Chemical cleaning process
- c) Pickling process
- d) Polishing process

Explanation. Ultrasonic cleaning is done in aqueous alkaline solution with high frequency vibrations from 20-450KHz.

Chemical cleaning process is used to remove unwanted contaminants (oils, grease, wax, metal chips, silica, rusts, light oxides etc.) from the work surfaces by chemical process.

Pickling is a metal surface treatment used to remove impurities (stains, inorganic contaminants, rust, aluminum alloys, oxide layers etc.). A solution called pickle liquor (strong acids) is used to remove the surface impurities.

Grinding is a material removal and surface generation process used to shape and finish components made of metals and other materials.

Polishing creates a smooth and shiny surface by rubbing or using a chemical action.

Q2. Diffusion of _____ into the metal to create a case hardened surface is known as nitriding.

- a) Silicon
- b) Argon
- c) Nitrogen
- d) Oxygen

Explanation. Nitriding is a heat treating process that diffuses _____ into the surface of a metal to create a case-hardened surface. These processes are most commonly used on high-carbon, low alloy steels. They are also used on medium and high-carbon steels, titanium, aluminium and molybdenum.

Q3. Match the following types of poration techniques in section – A with their corresponding type of physical energies in section – B

Section – A: 1. Electroporation, 2. Magnetoporation, 3. Thermoporation, 4. Sonoporation

Section – B: A. Ultrasound, B. Electric field, C. Magnetic field, D. Temperature

- a) 1-A, 2-C, 3-D, 4-B
- b) 1-B, 2-C, 3-D, 4-A
- c) 1-B, 2-D, 3-A, 4-C
- d) 1-C, 2-A, 3-D, 4-B

Explanation. The purpose of a drug delivery system is to devise a method that enables delivery of a therapeutic agent that may have sub-optimal physiochemical properties in biological tissue. The formation of temporary pores in the cell membrane achieved through the application of various physical energies.

Q4. Which of the following is the characteristics of carboxyl group?

- a) Polar and hydrophilic
- b) Polar and hydrophobic
- c) Non-polar and hydrophilic
- d) Non-polar and hydrophobic

Explanation. Carboxyl groups have an electronegative oxygen atom double bonded to a carbon atom. This carbon-oxygen bond is very polar and the fact that it's a double bond increases the polarity of the bond. As a result of the polarity, compounds containing carboxyl groups usually have higher melting points, boiling points and have hydrophilic centers.

Q5. The process involves impacting a surface with shot to create plastic deformation is

- a) Shot blasting
- b) Shot peening
- c) Explosive hardening
- d) Laser annealing

Explanation. It is a process involves impacting a surface with shot to create plastic deformation. This process induces compressive stress and relieves tensile stresses.

Q6. What kind of lens is used in laser annealing?

- a) Achromatic
- b) Electromagnetic
- c) Condensing
- d) Objective

Explanation. Laser annealing performs annealing using a laser with rapid heating the surface and allowing it to self-cool in open air. In the basic equipment, condensing lens is used for focusing at the surface of the material.

Q7. Which of the following is a property of a good electrolyte

- a) It must possess high electrical conductivity
- b) It should possess high specific heat
- c) It must be chemically stable and active
- d) All of these

Explanation. Properties of a good electrolyte are: it must possess high electrical conductivity, high specific heat, viscosity must be as low as possible, it must be chemically stable and active and it should not be toxic and corrosive.

Q8. Select a process in which, homogeneous nucleation takes place during chemical modification

- a) Pack cementation diffusion
- b) Thermos-chemical diffusion
- c) Cluster beam deposition
- d) Chemical conversion

Explanation. Cluster beam deposition is one of several techniques classified as ion-assisted thin film formation. The material to be deposited emerges and expands into a vacuum environment from a small nozzle of a heated confinement crucible. Homogeneous nucleation results in the generation of atomic aggregates or clusters by weak interatomic forces.

Q9. Relative humidity can be measured by _____

- a) Hydrometer
- b) Venturi meter
- c) Hygrometer
- d) Tachometer

Explanation. A hygrometer is an instrument used for measuring the moisture content in the atmosphere.

There are two main types of hygrometers – a ‘dry and wet bulb psychrometer’ and a ‘mechanical hygrometer’.

Wet and dry bulb psychrometers are the simplest and common device for measuring humidity. This type of hygrometer uses two basic mercury thermometers, one with a wet bulb and another with a dry bulb. Evaporation of water on the wet bulb causes its temperature reading to drop, causing it to show a lower temperature than the dry bulb. A mechanical hygrometer uses an organic material (usually human hair) that expands and contracts as a result of the surrounding humidity. The organic material is held under slight tension by a spring and linked to a needle gauge that indicates the level of humidity based on how the hair has moved.

Q10. Select a device used to detect the changes in magnetic field or current strength?

- a) Gas sensor
- b) Magneto-Optical sensor

- c) Humidity sensor
- d) Nanogenerator

Explanation. It is a device to take advantage of magneto-optical effects to detect the change in magnetic fields or current strength.

