Advanced Nanotechnology Principles

Nanotechnology · Answer Key · 8 Questions

1. Which phenomenon describes the transition where electronic, optical, and magnetic properties of materials deviate from bulk behavior as dimensions approach the nanoscale?

A) Quantum confinement
B) Superconductivity
C) Thermal expansion
D) Surface tension

2. In the context of carbon allotropes, what is the specific hybridization state of carbon atoms in a single-walled carbon nanotube?

A) sp
B) sp2
C) sp3
D) dsp2

3. Which top-down nanofabrication technique utilizes a focused beam of charged particles to remove material from a substrate with sub-10 nanometer precision?

A) Photolithography
B) Focused Ion Beam (FIB) milling
C) Atomic Layer Deposition
D) Self-assembly

4. What is the primary reason gold nanoparticles exhibit a deep red or purple color compared to the characteristic yellow of bulk gold?

A) Localized Surface Plasmon Resonance
B) Changes in chemical oxidation state
C) Refraction of light in vacuum
D) Quantum tunneling

5. Which analytical instrument is capable of manipulating individual atoms to create nanostructures by using a sharp conducting tip and quantum tunneling currents?

A) Scanning Electron Microscope
B) Transmission Electron Microscope
C) Scanning Tunneling Microscope
D) X-ray Diffraction

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6. What is the primary thermodynamic driving force behind the 'bottom-up' self-assembly of block copolymers into nanostructures?

A) Minimization of Gibbs free energy
B) Increase in gravitational potential energy
C) Uniform distribution of kinetic energy
D) Constant entropy change

7. Which material property is primarily responsible for the increased catalytic efficiency of metal nanoparticles?

A) High surface-area-to-volume ratio
B) Increased bulk density
C) Electrical conductivity
D) Magnetic permeability

8. What defines the critical length scale in 'nanotechnology' as defined by the ISO/TC 229 technical committee?

A) 1 to 100 nanometers
B) 1 to 500 nanometers
C) 10 to 1000 nanometers
D) 0.1 to 10 micrometers

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