



Questions for the Diploma Exam – NT II
Nanostructures and computer simulations in material science

1. Defects in solids. Relations between defects and properties of materials.
2. Semiconductor p-n and metal-semiconductor junctions: properties and applications.
3. Describe magnetic domains and explain why they are formed.
4. Describe giant magnetoresistance (GMR) and tunnel magnetoresistance (TMR).
5. Surface tension – give the definition and discuss consequences (an example).
6. Glass transition. How can we determine the glass transition temperature?
7. The sol-gel method for the synthesis of glasses and ceramics: basic stages and application.
8. Describe the particle confined in 1D, 2D and 3D.
9. Synthesis methods of nanomaterials.
10. Methods for imaging nanostructures: types, principles of operation, limitations.
11. Methods of nanomaterials physico-chemical properties examination.
12. Chemical and physical adsorption and its influence on surface properties.
13. Light emitting diodes and lasers: principle of operation and application.
14. Optical spectroscopy methods: brief characteristic, physical basis and their application for nanomaterials analysis.
15. Photoelectron spectroscopy (XPS) as a „surface sensitive” technique.
16. Differences between classical and quantum-based methods of computational analysis of nanoscale systems.
17. The molecular dynamics (MD) method: principle of operation, advantages and limitations.
18. Periodic boundary conditions in computer simulation. Why and when are they used, how do they work, what are their main limitations?
19. Kohn-Sham Density Functional Theory (KS-DFT): main principle of operation, advantages and limitations.
20. What is the exchange-correlation (XC) functional? Describe the "Jacob's ladder" of XC functionals.

Dziekan

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