

Topic list

The structure of atoms

Nucleons, isotopes, atomic number, atomic mass

The structure and energetics of atomic electrons

Electron-volt, electron-shells, population of electron -orbitals

Atomic bonds

Formation of chemical bond, potential energy, binding distance and energy, primer bond types, role of electro-negativity, secondary bonds, bond energies

State of matter

Solid, fluid, gas, range of the order, density, typical phase transitions

Gas phase

Ideal gas, universal gas law, Maxwell-Boltzmann distribution, Boltzmann distribution, examples

Fluids

General properties, fluid interfaces, surface tension, adhesion

Wetting a surface, special properties of the water

Liquid crystals

General properties, thermotropic liquid crystals, application, liotropic liquid crystals

Solid materials

General properties of solid materials, crystal structure, most frequent lattices, properties of crystals, polymorphism, allotropy, polycrystalline materials, types of crystal defects, Band structure of the crystalline materials, classification of the crystals on the bases of bond structure electric properties of the crystals

Amorphous solids

General properties, glass transition temperature

Structure analysis

Light microscope, image formation, magnification, resolution, Hygens principle, diffraction, condition of constructive and destructive interference, Electron microscope, De Broglie's idea, TEM, SEM (functioning and resolution of them) , STM, AFM, (functioning and resolution of them, piezoelectric effect), Diffraction methods, X-ray diffraction

Metals

General properties, crystal structure, microscopic structure, phase transition, phase diagram, crystallization, supercooling, nucleus formation, crystal growth,

Alloys, and characteristics of them

Solid solutions, general properties, classification, calculation of composition, phase diagram, composition in the different phases, metal compounds and properties of them, eutectic alloys, peritectic alloys, dental amalgam

Ceramics

Structure, defects in the ceramics, general properties, classification on the base of the application and on composition, Oxide-, silicate- and glass ceramics, formation and properties of them, dental applications

Polymers

Definition, classification on the base of composition, molecular weight, morphology, types of polymer chains, thermoplasts, thermosets, elastomers
synthesis of polymers, (addition, condensation) isomerisatio in macromolecules, properties of polymers, dental application of polymers (examples)

Composites

Definition, structure, parameters acting on properties, classification of composites, dental application, most important dental composites

Deformations

Types, testing, stress, atomic forces, examination of the stress, strain, stress-strain diagram, Hook's law, Young's modulus, elasticity, stiffness, effect of the temperature, stiffness of the material and the body, lateral changing, Poisson's ratio, bending, shearing, twisting.

Elastic behavior

Resilience, elastic strain recovery, elastic energy

Plastic deformation

Yield limit, strength, toughness, plasticity, brittleness, crystal slip, real system and engineering system, strength measurements

Fracture

Ductile and brittle fracture, impact test, ductile-brittle transition, hardness, types of the hardness.

Viscoelasticity

Ideal elastic body, viscosity, normal and abnormal fluid, ideal viscous body, viscoelasticity, models, creep, relaxation.

Fatigue

Type of loads, S-N curve, abrasion.

Thermal properties

Heat capacity, specific heat capacity, thermal conduction, conductivity, thermal diffusivity, thermal expansion, volumetric thermal expansion.

Light

Electromagnetic wave, superposition, diffraction, interference, photon, intensity.

Geometrical optics

Reflection, refraction, Snell's law, total internal reflection, application, dispersion of the light.

Spectroscopy, spectrophotometry

Scattering, absorption, attenuation, attenuation law, absorption spectrum, application.

Luminescence

Phenomenon, application, electronic states of electrons, life-time, quantum efficiency.

Optical properties

Origin of the color, color space, properties of the colors.

Electric properties

Voltage, current, Ohm's law, resistivity, conductivity.

Chemical properties

Corrosion, type of corrosion, corrosion of ceramics, degradation of polymers.

Properties of materials

Metals, increasing the strength, ceramics, crack sensitivity of ceramics, crack types, polymers, factors influencing the properties of polymers, composites, effect on properties.

Tissues

Hard tissues, soft tissues, structure and properties of collagen, enamel and dentin, biomechanics of arteries and muscles, sarcomere, titin.

Biopolymers

Shape, mechanics, elasticity, mechanical unfolding, mechanical stability of biopolymers.

Statics

Equilibrium of the point-like mass body, extended rigid body, torque, lever, application of the lever, lever in the human body, couple, system of forces

Forces in dentistry

masticatory force, measurement of this, transmission of force to the bone, bone remodeling, mechanism of remodeling, torque of the masticatory force

Testing methods in implantology

Optic methods, finite element method, stability tests

Orthodontics

Forces in the mouth, motions of the tooth, mechanism of the movements, forces and torques resulting movements, properties of the brace, restoring force, superelasticity, shape memory, selection of the material