Course Package

Materials Science and Engineering – 1B

Name module	Materials Science and Engineering – 1B
Course Code	202000633
Educational programme	BSc Advanced Technology
Period	Second quartile of the first semester (Block 1B)
Study load	30 ECTS
Coordinator	A.W. Schouwstra

Materials Science and Engineering			
Block 1A	**Block 1B**	**Block 2A**	**Block 2B**
	Advanced Materials 202000634 (3,5 EC)		
	Fundamentals of Solids 202000635 (3,5 EC)		
	Chemistry and Technology of Materials 202000636 (4 EC)		
	Electives: (1 of the 2)		
	Semiconductor Devices – 202000637 (4 EC)		
	Physical Chemistry of Interfaces - 202000638 (4 EC)		

Required preliminary knowledge: Basic Quantum Mechanics; Basic Materials Science.

202000634 - Advanced Materials

The course Advanced Materials deals with the relationships between material properties and microstructure/composition. The course provides knowledge and insight into the functional properties of various material classes, and it provides an understanding of the relations between microstructure and properties of materials. Topics to be discussed are magnetic materials, dielectric and optical materials, mechanical properties, electrical properties, and thermal properties.

The course consists of lectures on the structure and functional properties of several material classes (polymer, ceramic, and metal). In the lectures theory as well as practical cases are discussed. Furthermore, groups of 3 students will study a specific, technologically relevant material system, which will be presented to the other students.

202000635 - Fundamentals of Solids

This lecture series addresses a number of fundamental topics that are at the basis of modern materials science. Both thermodynamics and kinetic aspects of solids and solids formation are discussed. The fundamentals of thin film growth kinetics, the theory of nucleation and growth, phase diagrams, and the thermodynamics of phase transformations will be treated. Solid state aspects of the diffusion of atoms and ions in crystalline materials will also be addressed in detail.

202000636 - Chemistry and Technology of Materials

The course Chemistry and technology of materials deals with the relation between material synthesis and structure/composition. It will focus on the effect of specific synthesis techniques on the achieved microstructure, which determines the material properties, and therefore, can determines specific functionalities in materials.
The course consists of lectures on the relation between microstructure and applied synthesis techniques (thin film, thick film, bulk) of inorganic materials. Various physical vapour deposition techniques as well as chemical vapour techniques for films will be discussed as well as sol gel and sintering techniques for obtaining bulk materials. The effect of strain in materials, caused by epitaxial growth, will also be studied. Furthermore, groups of 3 students will study a specific, technologically relevant material system, which will be presented to the other students.

Electives: (1 of the 2)

202000637 - Semiconductor Devices

Microelectronics strongly affects our daily life. The amount of integrated microelectronic circuits (ICs) rises drastically in many applications such as automotive, telecommunication, health care, portable computing and internet (ICT). In addition there is a continuous trend in increasing the complexity of the basic electronics building block, the microchip, realized in advanced CMOS (complementary metal-oxide semiconductor) technology, partly driven by the desire for increasing functionality. The microchip is formed by several key components, basically semiconductor devices. This course describes the physical working of these basic semiconductor devices and translates those to electrical characteristics.
It covers an introduction to the classical electron devices: the pn-junction and the Metal-Oxide-Semiconductor Field-Effect Transistor (MOSFET). The physical working is illustrated using diagrams of energy, electric field, electrical potential and concentration, and the principal formulae for the simplified devices are treated. After the lectures and tutorials the students should understand the limits of the electrical performance of classical devices and should perform a literature survey on how to tackle these. Finally, they should write a 5-10 pages report about their findings.

202000638 - Physical Chemistry of Interfaces

The modules are tentative and subject to change. Please check the website *regularly.*

Physical Chemistry of Interfaces is a broad introduction in interfacial science. Interfaces are everywhere in our daily life and interface effects are in many cases crucial (for instance in the functioning of the lungs). Interfaces become increasingly important when we reduce the dimensions. The behaviour of nanoparticles is for instance, mostly determined by their interfaces. We'll explain the importance of interfaces in nanotechnology in this course.
We'll start the course with an introduction into wetting, capillarity and study the physical and chemical properties of different interfaces (solid-gas, solid-liquid, gas-liquid), with special attention for topics like the wetting properties of surfaces (contact angle), stability of colloidal systems (like emulsions and foams). We continue with kinetics: the mathematical description of (the speed) of reactions. Subsequently this knowledge is then applied on catalytic reactions, where we study adsorption and desorption of reactants and products, catalytic mechanisms, transport of the reactants/products and the identification of the catalytic mechanisms/materials in detail.

The modules are tentative and subject to change. Please check the website *regularly.*