

Faculty of Biological, Agronomic and Environmental Engineering

BRNA2102 Material surface characterisation

[52.5h+0h exercises] 4.5 credits

This course is taught in the 2nd semester

Teacher(s): Yves Dufrêne, Paul Rouxhet
Language: French
Level: Second cycle

Aims

The course aims at developing a detailed knowledge and a critical attitude regarding the surface analysis of solids. The students will acquire a know-how in the characterization of the chemical composition of surfaces, the texture of solids and the spatial organization of interfaces. Students will be asked to integrate this know-how with a global approach of the analysis of organized matter, starting from their skills in chemical analysis towards various application areas (materials, catalysis, biotechnology, #).

Main themes

The course presents an overview of methodologies for characterizing organized matter and their application to the surface of materials. It provides a link between the use of characterization methods and understanding associated physico-chemical phenomena. Three levels of characterization are covered, a specific technique being emphasized at each level. Each part of the course may be taken separately.

Partim A. Chemical analysis of surfaces with an emphasis on X-ray photoelectron spectroscopy : principle, instrumentation, qualitative and quantitative aspects of data interpretation.

Partim B. Gas adsorption and its use for characterizing the texture of solids: physical and chemical adsorption, different types of adsorption isotherms, application to specific surface area and porosity measurements.

Partim C. Scanning probe microscopies, emphasizing atomic force microscopy: instrumentation, imaging and force spectroscopy modes, applications dealing with engineering and bioengineering of surfaces.

The course combines the study of concepts, illustrations with practical examples and demonstrations on the instruments.

Content and teaching methods

Introduction

Overview of the characterization of complex solids : texture, composition, structure, specific properties.

A. Chemical analysis of surfaces. Context - Principles (electronic levels, elemental analysis of the surface) - Instrumentation - Qualitative aspects (main peaks and satellites, chemical shift and functional analysis) - Quantitative aspects (from the basic equation to the pragmatic approach, complex systems, models for interpretation).

B. Gas adsorption and characterization of surfaces. Physical and chemical adsorption - Organized study of the different types of adsorption isotherms: type II (BET), type IV (capillary condensation, porosity), type I (chemisorption, micropore filling), types III et V - Characterization of the texture of porous solids (know-how) - Equation of state - Heat of adsorption.

C. Atomic force microscopy. Instrumentation - Topographic imaging: principles, applications - Force spectroscopy: principles, applications - Other imaging modes.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

Prerequisites : General chemistry, physics and physical chemistry

Written examination

Support : Notes provided by the professors

Other credits in programs

BIR22/3C	Deuxième année du programme conduisant au grade de bio-ingénieur : Chimie et bioindustries (Nanobiotechnologies, matériaux et catalyse)	(4.5 credits)	Mandatory
MATR23	Troisième année du programme conduisant au grade d'ingénieur civil en science des matériaux	(4.5 credits)	