



Teaching Guide				
Identifying Data			2023/24	
Subject (*)	Surface Science	Code	610G04021	
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Third	Obligatory	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Canle López, Moisés	E-mail	moises.canle@udc.es	
Lecturers	Brandariz Lendoiro, María Isabel Canle López, Moisés	E-mail	i.brandariz@udc.es moises.canle@udc.es	
Web				
General description	This subject attempts an introduction to the highly interdisciplinary field of surface science. Surface behavior will be discussed based on their physicochemical properties. The role of surfaces on surface reactivity will be analyzed, as well as the relevance of surface modifications. In connection with all the above mentioned, different surface-study techniques will be mentioned. The adsorption phenomenon and its role in catalysis will be introduced. Finally, the basic aspects of interphase will be mentioned, as well as the characteristics of thin films.			

Study programme competences	
Code	Study programme competences
A1	CE1 - Comprender los conceptos, principios, teorías y hechos fundamentales relacionados con la Nanociencia y Nanotecnología.
A2	CE2 - Aplicar los conceptos, principios, teorías y hechos fundamentales relacionados con la Nanociencia y Nanotecnología a la resolución de problemas de naturaleza cuantitativa o cualitativa.
A3	CE3 - Reconocer y analizar problemas físicos, químicos, matemáticos, biológicos en el ámbito de la Nanociencia y Nanotecnología, así como plantear respuestas o trabajos adecuados para su resolución, incluyendo el uso de fuentes bibliográficas.
A7	CE7 - Interpretar los datos obtenidos mediante medidas experimentales y simulaciones, incluyendo el uso de herramientas informáticas, identificar su significado y relacionarlos con las teorías químicas, físicas o biológicas apropiadas.
B1	CB1 - Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio
B2	CB2 - Que los estudiantes sepan aplicar sus conocimientos a su trabajo o vocación de una forma profesional y posean las competencias que suelen demostrarse por medio de la elaboración y defensa de argumentos y la resolución de problemas dentro de su área de estudio
B5	CB5 - Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía
B6	CG1 - Aprender a aprender
B7	CG2 - Resolver problemas de forma efectiva.
C1	CT1 - Expresarse correctamente, tanto de forma oral como escrita, en las lenguas oficiales de la comunidad autónoma
C2	CT2 - Dominar la expresión y la comprensión de forma oral y escrita de un idioma extranjero
C8	CT8 - Valorar la importancia que tiene la investigación, la innovación y el desarrollo tecnológico en el avance socioeconómico y cultural de la sociedad

Learning outcomes	
Learning outcomes	Study programme competences



Understand the difference between the behavior on the bulk of a medium and on the surface.	A1 A7	B1 B6	C1 C2 C8
To be able to use the different theories and approaches available to reckon the effects of the surface	A2 A3	B2 B5 B7	
To know and understand interphase phenomena	A1 A7	B1 B5 B6	C1 C2 C8
To know and understand equilibrium phenomena on a surface	A1 A7	B1 B5 B6	C1 C2 C8

Contents	
Topic	Sub-topic
Characteristics and properties of surfaces	Characteristics and physical properties. Consequences. Characteristics and chemical properties. Consequences. Morphological and structural characteristics. Consequences.
Techniques for the study and characterization of surfaces	Physical properties Structure and morphology Chemical properties
Adsorption	Adsorbents and adsorbates Adsorption isotherms Physisorption Chemisorption
Interphases	Monolayers Films Charged interphases Exchange through the interphase
Reactivity on surfaces	Heterogeneous catalysis Surface modifications

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Laboratory practice	A2 A3 A7 B2 B7 C1 C2	15	1.5	16.5
Seminar	A1 A2 A7 B1 B6 B7	12	27	39
Mixed objective/subjective test	A1 A2 B1 B2 B7 C1	2.5	0	2.5
Directed discussion	A3 B2 B5 B7 C1 C2 C8	4	9	13
Guest lecture / keynote speech	A1 A2 A3 A7 B7 C8	28	49	77
Personalized attention		2	0	2

(\*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
Methodologies	Description
Laboratory practice	Experimental projects will be carried out directly related to the subject treated in different thematic blocks, and that complement it. The planning of the experiments, the obtaining of experimental results, their discussion, and their writing and presentation will be approached, following the different steps of the scientific method.



Seminar	This activity is designed to be carried out in groups as small as possible, with the aim of deepening in a dynamic and argumentative way different topics. Its success depends on the active participation of the students. Cases, problems, and questions related to the subject matter of the different thematic blocks will be addressed.
Mixed objective/subjective test	Combination of different types of questions: test and problem type, short answer or essay type, evaluating knowledge, reasoning capacity and critical spirit. It will be divided into two parts, a test and a development of problems and/or cases. Both will have the same value: 50% of the mixed test.
Directed discussion	This activity is designed to be carried out in groups as small as possible, with the aim of deepening in a dynamic and argumentative way different topics. Its success depends on the active participation of the students. Experimental data related to cases related to the subject will be discussed in small groups.
Guest lecture / keynote speech	Exposición con apoyo audiovisual o de pizarra en la que se exponen aspectos fundamentales de la asignatura, con posibilidad de participación del alumnado. Se contempla la participación, para un número reducido de horas, de profesorado colaborador especialista en la materia.

**Personalized attention**

Methodologies	Description
Laboratory practice Seminar Directed discussion	<p>The aim is to guide the students in the understanding of the subject and in the resolution of the problems that may arise during the study, as well as in the possible strategies to solve them.</p> <p>Its development will be fixed jointly between teachers and students according to their needs. It will be carried out in the teachers' offices. It will be distributed in a maximum of 12 sessions of 15 minutes during the four-month period.</p> <p>Students with a part-time admission and academic dispensation of exemption from attendance must attend at least one personal tutorial for each seminar (=8 tutorials) and one for each two case studies (=4 tutorials), in a schedule previously agreed with the teachers, which could be complemented with asynchronous tutorials for the rest of the subject.</p> <p>Translated with <a href="http://www.DeepL.com/Translator">www.DeepL.com/Translator</a> (free version)</p>

**Assessment**

Methodologies	Competencies	Description	Qualification
Laboratory practice	A2 A3 A7 B2 B7 C1 C2	Assessment includes: experimental planning, operational aspects, understanding of the strategies and methodologies used in the execution of the projects, rigor and reproducibility in obtaining experimental results, critical analysis of the results, ability to extract regularities, generalize and reach conclusions from the discussion of the results obtained.	15
Seminar	A1 A2 A7 B1 B6 B7	Assessment includes: operational aspects, understanding of the strategies and methodologies used to solve the cases, critical analysis of the results obtained.	20
Mixed objective/subjective test	A1 A2 B1 B2 B7 C1	Final examination with two parts, one of theoretical cut (50%) that includes test type questions, short answers, and/or essay, and another one of the case or problem-solving (50%), in which the ability in the application of the theoretical contents for problem-solving will be evaluated.	50
Directed discussion	A3 B2 B5 B7 C1 C2 C8	The evaluation is based on the ability to apply the different concepts discussed throughout the course in the analysis of the cases presented.	15

**Assessment comments**



The aim is to evaluate the acquisition of knowledge, critical capacity, synthesis, comparison, elaboration, application and originality of the students. For a suitable use of the subject, the students must attend all the activities present.

The realization of the practices is a basic criterion to pass the subject. Without doing the practicals, it will not be possible to pass the course, independently of the weight of the practicals in the evaluation.

\* First opportunity. In order to take into account the activities of case studies and oral presentation, it is necessary to obtain a minimum grade of 4.0/10 in each of the two parts of the mixed test. The final grade is obtained by applying the established percentages and the previously established restrictions.

\* Second opportunity. The parts of the mixed exam that have not been passed may be repeated, and the activity established as equivalent to the directed discussion may be handed in in writing. The activities related to the work developed in the seminars will be considered unrepeatable. The final qualification will be obtained by applying the established percentages and the previously established restrictions.

In any of both opportunities, if a minimum qualification of 4.0/10 is not achieved in each of the parts of the mixed test, the subject will be considered as failed even if the final qualification, calculated according to the corresponding percentages, is equal or higher than 5/10. In this case, the final grade will be 4.5/10.

Honours: if there are several students with the same qualification who can opt for the MH, and the number of MH available is less than the number of students, they will be called to a written test. The students who were evaluated in the second opportunity will only be able to opt for the MH if the number of MHs was not covered in its totality in the first opportunity.

"Not presented" qualification: applies to students who participate in activities that represent less than (

### Sources of information

<b>Basic</b>	- K.W. Kolasinski (2012). Surface Science: Foundations of Catalysis and Nanoscience. Chichester: John Wiley & Sons, Ltd. - G.A. Attard, C. Barnes (1998). Surfaces. Oxford: Oxford University Press
<b>Complementary</b>	- H. Lüth (1995). Surfaces and Interfaces. Berlin: Springer - D.P. Woodruff, T.A. Delchar (1994). Modern Techniques of Surface Science . Cambridge: Cambridge University Press

### Recommendations

#### Subjects that it is recommended to have taken before

Thermodynamics: Equilibrium and Phases/610G04018  
Spectroscopy/610G04017

#### Subjects that are recommended to be taken simultaneously

Techniques of Characterisation of Nanomaterials 1/610G04025  
Solid State/610G04022

#### Subjects that continue the syllabus

Techniques of Characterisation of Nanomaterials 2/610G04030  
Kinetic and Catalysis/610G04026

### Other comments

- It is recommended to review assiduously the theoretical concepts introduced in the lectures, as well as to solve simultaneously the questions and exercises that will be proposed.- It is not advisable to study only through the class notes. It is advisable to elaborate your own materials by completing the notes.- It is strongly recommended to make use of the tutorial hours to clarify doubts and deepen the knowledge.- Green Campus Program of the Faculty of Sciences. To help achieve an immediate sustainable environment and comply with point 6 of the "Environmental Declaration of the Faculty of Science (2020)", the work of this subject will be requested in virtual format and computer support.-&nbsp;Perspective of gender: such and as if it collects in the transversal competitions of the title (C4), will promote the development of a critical citizenship, opened and respectful with the diversity in the our society, highlighting the equality of rights of the students without discrimination by question of gender or sexual condition. It Will employ a language inclusiva in the material and in the development of the sessions.It Will work to identify and modify preuizos and attitudes sexistas and will influence in the surroundings to modify them and promote values of respect and equality.



(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.