UNIVERSITY OF BUCHAREST
FACULTY OF CHEMISTRY
Master: Chemistry of Advanced Materials

SYLLABUS

Dicipline: MICRO AND NANOSTRUCTURED POLYMER MATERIALS. THERMAL ANALYSIS

Lecturer: Assoc. prof. Bogdan JURCA and Assoc. prof. Marian MICUT

No. of lecture hours: 28
No. of hours for practical activities: 28
Nr. of credits: 5
Form of examination: Written examination

Lectures: 20 hours

No.	Lecture topic	No. of hours
1	**Introductory notions**. Defining macrometric and nanometric domains in obtaining structured materials. General features and peculiarities on descendant (top-down) and ascendant (bottom-up) technologies in micro and nanostructured materials fabricati	2
2	**Thermodynamic stability of binary mixtures**: regular solutions, polymer solutions, polymer blends	2
3	**Phase separation** – an optimal approach in obtaining micro and nanostructured polymer-based films	2
4	**Binodals and spinodals**. Micro and nanostructures resulted via spinodal decomposition	2
5	**Block copolymer self-assembly and nanostructures formation**	2
6	**Miniemulsion polymerization and synthesis of polymer nanoparticles**	2
7	Polymer-based biomaterials used in tissue engineering	2

Disclaimer: This Summer School is realised with the EEA Financial Mechanism 2014-2021 financial support. Its content (text, photos, videos) does not reflect the official opinion of the Programme Operator, the National Contact Point and the Financial Mechanism Office. Responsibility for the information and views expressed therein lies entirely with the author(s).

8	**General principles of thermal analysis.** Presentation of commonly used methods (TG, DTA and DSC). Physico-chemical informations obtained from these methods (exampl	2
9	**Heterogeneous reactions with participation of solid phases**. Kinetic influence of nucleation and diffusion. **Isothermal heterogeneous processes**: derivation of kinetic equations, parallelism with the kinetic treatment of homogeneous systems, differential/integral forms of the conversion function.	2
10	**Nonisothermal heterogeneous processes**: differential/integral forms of the kinetic equation, temperature integral evaluation problem.	2
11	Calculation of the conversion degree from experimental TG and DSC data; classification of methods to determine the nonisothermal kinetic parameters. Methods to determine the nonisothermal kinetic parameters from a single heating rate experiment: differential methods.	2
12	Methods to determine the nonisothermal kinetic parameters from a single heating rate experiment: integral methods. Drawbacks of the methods based on a single heating.	2
13	Isoconversional methods to determine the activation energy: Linear isoconversional (integral and differential) methods. Nonlinear isoconversional (integral and differential) methods.	2
14	Methods to discriminate the expression of the conversion function Compensation effect in nonisothermal kinetics. Invariant kinetic parameters method	2

Practical activities: 28 hours

No.	Practical activity subject	No. Of hours

Disclaimer: This Summer School is realised with the EEA Financial Mechanism 2014-2021 financial support. Its content (text, photos, videos) does not reflect the official opinion of the Programme Operator, the National Contact Point and the Financial Mechanism Office. Responsibility for the information and views expressed therein lies entirely with the author(s).

1	General safety and security rules. Viscoelsatic behavior of a polymeric hydrogel revealed by dynamic-oscillatory rheology.	2
2	Study of in vitro fibrillogenesis of type I collagen	4
3	Synthesis of polymer nanoparticles: miniemulsion polymerization of methyl methacrylate	4
4	Obtaining a colloidal crystal by quasistatic self-assembly, from aqueous suspension, of monodisperse PMMA spheres onto a borosilicate glass substrate. Visible light diffraction as a method of assessing freshly deposited colloidal crystal: transparency to visible light and particle size estimat.	4
5	Presentation of the thermal analysis experimental setup. Experimental study of the decomposition of calcium oxalate. Interpretation of the experimental curves (attribution and validation of the thermal decomposition mechanism).	4
6	Kinetic interpretation of the data obtained at thermal decomposition of calcium oxalate: methods based on a single heating rate. Critical analysis of the obtained results.	4
7	Study of the thermal decomposition of polyvinyl chloride by TG, DTG and DTA. Calculation of the kinetic parameters by isoconversional methods from multiple heating rate experiments. Critical analysis of the obtained result.	4
8	Discrimination of the conversion function expression for thermal decomposition of polyvinyl chloride in nonisothermal condition.	2

Recommended bibliography

1.Course notes
2. W.T.S. Huck (editor) – Nanoscale Assembly. Chemical Techniques, Springer Science+Business Media, Inc., New York, 2005
3. B. Bhushan (editor) – Springer Handbook of Nanotechnology, Springer Science+Business Media, Inc., Heidelberg, 2004
4. M. Di Ventra, S. Evoy, J.R. Heflin, Jr. (editori) – Introduction to Nanoscale Science and

Technology, Springer Science+Business
Media, Inc., Boston, 2004
5. I.G. Murgulescu, E. Segal - Introducere în Chimia Fizică, vol.II.1, Teoria Molecular-Cinetică a Materiei, Editura Academiei,
Bucureşti, 1979
6. I.G. Murgulescu, T. Oncescu, E. Segal - Introducere în Chimia Fizică, vol.II.2, Cinetică Chimică şi Cataliză, Editura Academiei,
Bucureşti, 1981
7. E. Segal, D. Fătu - Introducere în Cinetica Neizotermă, Editura Academiei, Bucureşti, 1983
8. W. M. Groenewoud – Characterisation of Polymers by Thermal Analysis, Elsevier, 2001
9. Michael E. Brown (editor) – Handbook of Thermal Analysis and Calorimetry – vol.1 – Principles and Practice, Elsevier 1998
10. Stephen Z. D. Cheng (editor) - Handbook of Thermal Analysis and Calorimetry – vol.3 – Applications to Polymers and Plastics,
Elsevier 2002
11. Michael E. Brown, Patrick K. Gallagher (editors) - Handbook of Thermal Analysis and Calorimetry – vol.5 – Advances, Techniques
and Application, Elsevier 2008
12. Michael E. Brown (editor) – Hot Topics in Thermal Analysis and Calorimetry – vol.1 – Introduction to Thermal Analysis –
Techniques and Applications, Kluwer Academic Publishers, 2001
13. Judit Simon (editor) – Hot Topics in Thermal Analysis and Calorimetry – vol.7 – Thermal Decomposition of Solids and Melts,
Kluwer Academic Publishers, 2007
14. Paul Gabbott (editor) – Principles and Applications of Thermal Analysis, Blackwell Publishing, 2008
15. T. Hatakeyama, F.X. Quinn - Thermal Analysis - Fundamentals and Applications to Polymer Science, 2nd edition, John Wiley and
Sons, 1999
16. P. J. Haines (editor) - Principles of Thermal Analysis And Calorimetry, Royal Society of Chemistry, 2002
17. Bernhard Wunderlich - Thermal Analysis of Polymeric Materials, Springer 2005
18. A. K. Galwey, M. E. Brown – Thermal Decomposition of Ionic Solids, Elsevier 199