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Universidad del País Vasco

Euskal Herriko Unibertsitatea

KIMIKA FAKULTATEA

FACULTAD DE QUÍMICA

Synthesis of Polymer Nanoparticles

Prof. Radmila Tomovska

The subject covers 3 credits:

20 hours of theoretical lectures

8 hours laboratory exercise

2 hours invited seminars

20 hours of theoretical lectures

1. ***Reactive pathways to nanoparticle formation***

   1.1 Conventional radical polymerization in heterogeneous media: Polymerization in emulsion, miniemulsion, microemulsion, dispersion, suspension, inverse emulsion (in organic phase).

   1.2 Controlled radical polymerization in heterogeneous media: Nitroxide-mediated polymerization, radical addition fragmentation transfer polymerization, etc.

   1.3 Polymerization systems: Semi-batch and batch processes; continuous processes

   1.4 Particles morphology: Two-phase polymer-polymer structured particles

2. ***Non-reactive pathways to nanoparticles formation***

   2.1 Self-assembling in soft and hard templates

   2.2 Stretching

   2.3 Compression

   2.4 Nanoprecipitation

   2.5 Solvent evaporation

2.6 Heterocoagulation

2.7 Supercritical fluid technology

3. Characterization of polymeric nanoparticles

3.1 Molecular structure: NMR, UV, IR, Raman and mass spectroscopy

3.2 Molecular size: Average molar masses and the molar mass distribution (MMD) by Size exclusion chromatography (SEC) and Field Flow Fractionation (FFF),

Particle size and distribution (Electron Microscopy (SEM; TEM; AFM); Ensemble techniques (laser diffraction and light scattering methods: dynamic light scattering (DLS); Particle movement methods capillary hydrodynamic chromatography (CHDF) and Disc Centrifuge Photosedimentometer (DCP);

3.3 Molecular organization: Branching density (NMR spectroscopy); Cross-linking density (spectroscopy methods, swelling experiments and DMTA analysis).

4. Application of polymeric nanoparticles

4.1 Waterborne paints, Adhesives and Coatings

4.2 Electronics and Optoelectronics

4.3 Biotechnological and Biomedical products

8 Hours Laboratory Exercises

4 h Synthesis of polymer nanoparticles using techniques of emulsion and miniemulsion polymerization

4h Characterization of the synthesised polymer nanoparticles

Two invited seminars:

1. Application of Matrix-Assisted Laser Desorption/Ionization Time Of Flight Mass Spectrometry (MALDI-TOF MS) technique for polymer characterization
2. Capillary hydrodynamic fractionation (CHDF) for high-resolution determination of particle size distribution in aqueous polymer dispersions