UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Advanced Syntheses of Polymers

2223-2-F5401Q074

Aims

The aim of the course is to provide students an introduction to modern methods of polymer synthesis, specifically focused on the advanced polymerization mechanisms and polymers of interest for the chemistry of formulation. Moreover, a particular emphasis will be given to the structure and properties of natural/biobased polymers.

The students will master the state-of-the-art in chain growth polymerisation methods, the links between controlled and living polymerization methods and the molecular characteristics of the resulting polymer chains (molar mass, chain dispersity, architecture). Furthermore, the students will gain a significant knowledge about the impact of the innovative polymerization methods on the industrial processes as well as the sustainability of the most promising natural/biobased polymers.

Contents

Studies synthesis of polymeric materials, emphasizing interrelationships of chemical pathways, process conditions, and microarchitecture of molecules produced. Living and quasi living techniques are discussed, including reversible addition a fragmentation transfer polymerizations (RAFT) and atom transfer free radical polymerizations (ARTP), catalytic approaches to well-defined architectures, and polymer functionalization in bulk and at surfaces. Process conditions include bulk, solution, emulsion, suspension, gas phase. Microarchitecture includes tacticity, molecular-weight distribution, sequence distributions in copolymers.

Detailed program

Modern Methods for Polymer Synthesis

1 Introduction: Living and controlled chain polymerizations

2. Atom-transfer radical polymerizations (ATRP)

3. Nitroxide-mediated radical polymerizations (NMP)

4. Reversible addition-fragmentation chain-transfer polymerizations (RAFT)

5. Polymerization Induced Self Assembly (PISA)

6. Anionic polymerizations

7. Living ring-opening polymerizations (LROP).

8. Organocatalytic ring-opening polymerizations

9. Ring Open Methathesis Polymerization (ROMP)

10. Polymer synthesis exploiting click reactions

Reactive Modification of Polymers and Blending

1. Reactive extrusion

2. Polymer Rheology

3. Polymer and copolymer blending

4. Additives in polymers: synthesis and interactions of additives with polymer chains (plasticizers, dyes ect.)

Bioplastics and Biobased Polymers

1. Structure, properties, applications of natural polymers. Modification of carbohydrate polymers and cellulose based polymers, lignin, fibroin, keratin and protein based polymers

2. Synthetic approaches, properties and application of biobased and biodegradable polymers (polylactid acid, polyglicolic, polyhydroxyalcanoates)

Prerequisites

Basic knowledge of polymer chemistry

Teaching form

Lectures in classroom

Textbook and teaching resource

Scientific publications relating to the specific topics of the course will be provided

Powerpoint presntation containing the lessons

Semester

Firts semester

Assessment method

The exam consists of an oral exam in which the topics presented in the lessons are discussed. In addition to learning the fundamentals presented in the course, the student's skills and aptitudes are also assessed to adapt the theoretical foundations of polymer sinthesys to particular operational and practical conditions; the exhibition capacity and adequacy of the student's language is evaluated.

Office hours

On tuedsay from 2:00 to 4:00 in instructor's office

Sustainable Development Goals

RESPONSIBLE CONSUMPTION AND PRODUCTION