Polymer Chemistry - Video course

COURSE OUTLINE

- Introduction to macromolecules
- Polymerization processes
- Polymers in solution
- Characterization of macromolecules
- Reaction of macromolecules
- Polymer properties

COURSE DETAIL

Lectures	Topic/s	Sub-Topics
1-3	Introduction	Definitions, origin, nomenclature, classification of macromolecules; molecular weight (MW) and its distribution; thermal transitions; thermodynamics of polymerization.
4-7	Step Polymerization	Reactivity of functional groups; kinetics; molecular weight in open and closed system - Carother's equation; stoichiometric control of MW; cyclization vs. linear polymerization, cross-linking and gel point; process condition; step-copolymerization, examples of step polymers.
8-13	Radical Chain Polymerization	Nature of chain polymerization and its comparison with step polymerization; radical vs. ionic polymerizations; structural arrangements of monomer units; kinetics of chain polymerization; molecular weight and its distribution; chain transfer, inhibition, retardation, auto-acceleration; energetic characteristics; techniques of radical polymerization – bulk, solution, emulsion, suspension polymerization; examples of polymers made by radical chain polymerization.
14	Living radical polymerization	Theory; nitroxide-mediated polymerization (NMP); atom transfer radical polymerization (ATRP); radical addition-fragmentation transfer (RAFT); others.
15-16	Ionic chain polymerization	Comparison of radical and ionic polymerizations; cationic polymerizations - kinetics, mechanism; anionic polymerization - kinetics, mechanism; living anionic polymerization; examples.

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Chemistry and Biochemistry

Pre-requisites:

Introductory Physical, Organic and Inorganic Chemistry

Coordinators:

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17-18	Chain co-polymerization	General considerations; types of copolymers, copolymer compositions, reactivity ratio; radical and ionic copolymerizations; examples.
19-21	Stereoregular polymerization	Origin and types of stereoisomerism in polymers; factors influencing stereoregulation; properties of stereoregular polymers; stereospecific ionic polymerizations; coordination polymerization; Ziegler-Natta polymerization, metallocene polymerization; examples
22	Other polymerization processes	Ring opening polymerization; group transfer polymerization; metathesis polymerization, etc.
23-25	Polymers in solution	Thermodynamics of polymer solutions; Flory-Huggins theory, theta conditions; solubility parameters; fractionation of macromolecules
26-27	Chain dimensions	Freely joined chain; effect of geometric and volume restrictions; frictional properties of macromolecules in dilute solution.
28-33	Characterization of macromolecules	Determination of molecular weight - methods for measuring number average, weight average, viscosity average MW; gel permeation chromatography; spectroscopic techniques to determine chemical composition and molecular microstructure.
34-36	Reaction of macromolecules	Reactions with polyolefins, polyenes, pendant groups; polymer degradation - thermal degradation, degradation by catalyst residues, degradation by end groups; mechanism of stabilization - antioxidants and heat stabilizers, catalyst quenchers, end-capping;
37-38	Polymer properties and supermolecular structure	Properties of solid polymers, amorphous and crystalline phases of polymers, structure-property relationship.
39	Special topics/ Newer topics	Naturally occurring polymers, biodegradable, biosynthesis, polymers from bio/renewable resources.
40	Summary	

References:

1. Principles of Polymerization, 4th edn. George Odian, Wiley
2. Introduction to Polymers, 2nd edn. R. J. Young and P. A. Lovell, Nelson Thrones
3. Contemporary Polymer Chemistry, 3rd edn. H. R. Allcock, F. W. Lampe

and J. E. Mark, Pearson

4. Polymers: Chemistry and Physics of Modern Materials, J.M.G. Cowie, CRC Press
5. Introduction to Physical Polymer Science, L. H. Sperling, Wiley