

SYLLABUS

Name: Synthesis of liquid crystals (WTCCXCSM-SLC)

Name in Polish:

Name in English: Synthesis of liquid crystals

Information on course:

Course offered by department: Faculty of Advanced Technologies and Chemistry

Course for department: Faculty of Advanced Technologies and Chemistry

Term: Summer semester 2025/2026 Year

Cordinator of course edition: dr hab. inż. Przemysław Kula prof. WAT

Default type of course examination report:

Graded pass

Language:

English

Course homepage:

<https://www.wtc.wat.edu.pl/>

Short description:

Introduction to the field of liquid crystals its main present applications. Introduction to correlations between molecular structure and liquid crystalline properties with special attention to the field of fluorinated organic materials. Short survey over main generations of liquid crystals and main classes of intermediates, their importance and synthesis.

Description:

Introduction. Liquid Crystals (LCs). Classes of liquid crystals their structures and properties. Anisotropic properties of liquid crystals

Applications of LCs. The principles of display's operations. LCD switching modes. Direct View Displays. Projection microdisplays.

Reflective vs transmissive microdisplays. Non display applications. Properties of LCs related to LCD technologies

Determination of LC phases. Liquid Crystals textures. Polarizing thermomicroscopic measurements. Miscibility study. Phase diagrams.

Microcalorimetric measurements. X-ray measurements. Electrooptic and dielectric phase characterization.

Liquid Crystals mixtures. Phase transitions, thermodynamics of binary mixtures, ideal mixtures, non additive behavior, CSL equations, LC mixtures formulations

Fluorinated LCs. Carbon-Fluorine bond character. Comparison of fluorinated organic materials with non-fluorinated ones. Fluorinated LCs.

Sources of fluorinated intermediates and their synthesis. Survey of fluorination methods.

Synthesis of Liquid Crystals. Synthesis of main classes of LCs. Synthesis of main intermediates. Designing of synthetic routes of some chosen mesogens. Purification and analytical methods. Synthesis of chiral LC materials.

Laboratory classes of Liquid Crystals synthesis. Safety precautions. Multistep synthesis of one compounds from two group of nematic LCs.

Characterization of Liquid Crystal phases of obtained product

Bibliography:

Basic:

Sivaramakrishna Chandrasekhar "Liquid crystals" Cambridge University Press 1977

Dietrich Demus "Physical properties of liquid crystals" John Wiley & Sons 2009

Peter J. Collings "Introduction to Liquid Crystals: Chemistry and Physics" Taylor & Francis 1997

Additional:

Set of original papers from the synthesis methods used in synthesis of Liquid Crystals.

Learning outcomes:

W1 To know the fundamentals of liquid crystals and the relation between the molecular structure and the properties. K_W03, K_W10

W2 To know the way of designing the multistep organic synthesis K_W04, K_W09

W3 To know the relations between molecular structure and IR, ¹HNMR, UV-VIS, MS spectrums. K_W10

W4 To know the basic organic synthesis methods and techniques and the names of the most common labware and glassware. K_W04

U1 Is able using gathered knowledge, propose methods of synthesis of simple organic compounds. K_U01 K_U11, K_U14

U2 Is able to predict and analyse main side reactions usually present along with main organic reactions. K_U04

U3 Is able to design multistep synthesis and propose the synthesis conditions using available literature and other sources of scientific knowledge. K_U03, K_U10, K_U11, K_U16

U4 Is able to set the organic reaction and purification systems using common labware and glassware. K_U03

K1 Is aware of the level of own knowledge and is able to self-containedly correct the directions of the self-education. K_K01

K2 Is able actively and responsibly cooperate in the given group during solving theoretical as well as practical tasks. K_K02 K_K04

K3 Is aware of the importance of the organic chemistry and materials chemistry in science and current society. K_K04

Assessment methods and assessment criteria:

The subject is accepted basing on the positive result of examination procedure.

The examination form: written + oral: the solution three chosen problems of the following topics: organic synthesis of LCs, molecular design and LC properties correlations - which are given as a set of problems during the semester.

Mark 5 - three comprehensive answers

Mark 4.5 - two comprehensive answers and one middling answer

Mark 4 - one comprehensive answer and two middling answers or two comprehensive answers

Mark 3.5 three middling answers or one comprehensive answer and one middling answer

Mark 3 - two middling answers

The needful requirement is written laboratory report from the organic synthesis labs according given template.

Effects W1, W2, U1, U2, U3, K1, K3 are evaluated during examination.

Effects W3, W4, U1, U4, K2 are evaluated during organic synthesis labs.

Mode of study

full-time studies

Form of study

second-cycle studies

Introductory subjects
<p>Basic general chemistry course Initial requirements: the knowledge of principles of chemistry, basic correlations of chemical structure with its physicochemical properties, basic knowledge of quantum chemistry and classical thermodynamics</p> <p>Basic physics course Initial requirements: basic knowledge of principles of optics and electromagnetism and electrical properties of materials</p> <p>Basic organic chemistry course Initial requirements: basic knowledge related to first (BSc or equivalent) level of organic chemistry</p> <p>Basic preparative chemistry laboratories Initial requirements: basic skills in setting up the conventional reaction glass systems, basic skills in reaction work-up and purification of organic compounds</p>
Programs
field of study: chemistry
Form of course / number of hours / final requirement
<p>Lectures: 14h/+ Labs: 16h/+</p>
Author
płk dr hab. inż. Przemysław Kula, prof. WAT
ECTS balance
<p>1 Participation in lectures 14 2 Independent study of lecture topics 14 3 Participation in laboratories 16 4 Independent preparation for laboratories 14</p> <p>hours / ECTS Total student workload 58 / 1 Teacher classes: 30 / 1 Practical activities: 58 / 2 Activities related to scientific activities: 28 / 1</p>
Information on course edition:
Default type of course examination report:
Graded pass
Bibliography:
<i>missing bibliography in English</i>