

# KOLOKVIUM 2023

**Ústav makromolekulární  
chemie AV ČR, v. v. i.**

Heyrovského náměstí 2  
162 00 Praha 6

**27. 2. – 2. 3. 2023**

# 31. KOLOKVIUM



# K O L O K V I U M

Kolokvia jsou od roku 1992 výroční interní konferencí Ústavu makromolekulární chemie AV ČR, v. v. i.

Reflektují celosvětové trendy základního a aplikovaného výzkumu v oboru makromolekulární chemie a hlavní směry výzkumu ÚMCH AV ČR.

Nabízejí zaměstnancům ústavu a dalším hostům prostor pro odbornou diskuzi nad aktuálními výsledky řešených výzkumných projektů s možností rozvíjet vzájemnou spolupráci.

Součástí Kolokvia jsou také přednášky pracovníků ústavu oceněných v minulém roce – Elišky Grosmanové, Sachina Gupty a Matěje Víchy.

V rámci čtvrtěční sekce **Jak se dělá věda jinde** přivítáme Mariyu Shamzy z Univerzity Karlovy, Janu Navrátilovou z Univezity Tomáše Bati, Jaroslava Kučeru z Polymer Institute Brno, Samuela Gallata z firmy Wipak, Michaelu Rumlovou a Jana Mernu z Vysoké školy chemicko-technologické.

**Těšíme se na Vás na našem 31. Kolokviu**

**2023**

# P R O G R A M

## Pondělí 27. 2.

9:00 **Jiří Kotek, Petr Šálek**  
Zahájení

9:10

9:10 **A1 Andres de los Santos Pereira**  
Grafting density and fouling resistance of poly(HPMA) brushes prepared by “grafting to” and “grafting from”

9:35 **A2 Radoslava Sivkova**  
Polymer brushes based on *N*-methacryloxysuccinimide as platform for versatile post-polymerization modification

10:00 **A3 Dana Kubies**  
Polyelectrolyte assemblies for delivery of bioactive proteins supporting cell responses

Centrum BIOMOL

10:25 **PŘESTÁVKA** Káva a diskuze u posterů

10:55 **A4 Małgorzata Świątek**  
Antioxidant-modified magnetic nanoparticles vs. reactive oxygen species

11:20 **A5 Jakub Širc**  
Hydrogel implants for transscleral drug delivery in the treatment of retinoblastoma

11:45 **A6 Miroslava Dušková Smrčková**  
Stimuli-responsive hydrogels: External deformation as a trigger. Predicting the phenomenon and struggling for experimental evidence.

Centrum BIOMOL

12:10 **PŘESTÁVKA** Oběd

13:30

13:30 **A7 Ondřej Lidický** (studentská prezentace)  
Antibody polymer drug conjugates

13:55 **A8 Michaela Hrochová** (studentská prezentace)  
One-step synthesis to hydrolytically degradable polymer diblocks

14:20 **A9 Bohumila Podhorská** (studentská prezentace)  
Study of the stem cell interaction with biocompatible hydrogel scaffolds designed for tissue engineering

Centrum BIOMOL



# P R O G R A M

## Úterý 28. 2.

9:00

- 9:00 **A10 Richard Laga**  
Bio-responsive polymer probes for X-nuclei magnetic resonance spectroscopy imaging
- 9:25 **A11 Diana Oleshchuk** (studentská prezentace)  
Nanogels from biocompatible polymer precursors
- 9:50 **A12 Martina Vragovic** (studentská prezentace)  
Responsive polymer-lipid hybrid giant vesicles

Centrum BIOMOL  
a SUPRAMOL

10:15 **PŘESTÁVKA** Káva a diskuze u posterů

- 10:45 **A13 Volodymyr Lobaz**  
Synthetic polymers in physiological media: The isothermal titration calorimetry study
- 11:10 **A14 Zulfiya Černochová**  
Supramolecular melittin encapsulation by tuned charge compensation with polymer carriers
- 11:35 **A15 Vladimír Sincari** (studentská prezentace)  
Stimuli-responsive self-assembled polymer systems for drug delivery

Centrum SUPRAMOL

12:00 **PŘESTÁVKA** Oběd

13:30

- 13:30 **A16 Vladimír Raus**  
Synthesis of complex polymeric architectures via Cu-RDRP initiated by the adducts of trichloroacetyl isocyanate
- 13:55 **A17 Rafal Poreba**  
Surface-initiated controlled polymerization of (meth)acrylamides for advanced biointerfaces
- 14:20 **A18 Věra Cimrová**  
Formamidinium lead iodide perovskite thin films and interesting hybrid layers of conjugated copolymers for photonics
- 14:45 **A19 Yadu Ram Panthi** (studentská prezentace)  
Memristors for emerging organic memory devices and neuromorphic computing

Centrum SUPRAMOL a OPTOEL

# P R O G R A M

## Středa 1. 3.

9:00

9:00 **A20 Jiří Czernek**

On the C–H...O interchain interactions in polymers

9:25 **A21 Ivana Šeděnková**

Influence of oxidant on the photoacoustic response of polypyrrole nanoparticles / Presentation of Renishaw inVia Qontor Raman Microspectrometer

9:50 **A22 Doebner von Tumacder** (studentská prezentace)

Electrochemical properties of polypyrrole films prepared in the presence of organic dyes

Centrum STRUCTURE  
a OPTOEL

10:15

**PŘESTÁVKA** Káva a diskuze u posterů

10:45 **A23 Miroslav Otmar**

Chiral selective membranes for the separation of racemic mixtures

11:10 **A24 Adam Strachota**

Self-healing and super-elastomeric polyMEA-co-SMA nanocomposites crosslinked by clay platelets

11:35 **A25 Miroslav Šlouf**

Micromechanical properties: Our contribution to Encyclopedia of Polymer Science and Technology

Centrum OPTOEL  
a MATER

12:15

**PŘESTÁVKA** Oběd

13:30

13:30 **A26 Zdeněk Starý**

Fused filament fabrication of beta-nucleated polypropylene

13:55 **A27 Kateřina Skleničková** (studentská prezentace)

Biodegradation of aliphatic polyurethane foams in soil and effect on microbial population development

14:20 **A28 Ehsan Naderi Kalali**

Eco-friendly and bio-based flame-retardant treatment of cotton fabric by a one-pot ultra-fast deposition approach

14:45 **A29 Hynek Beneš**

Ionic liquid-mediated epoxy ring opening: A dual curing or fake news?

Centrum MATER



# P R O G R A M

## Čtvrtek 2. 3.

### 10:00 Přednášky oceněných pracovníků

- 10:00 **B1 Eliška Grosmanová**  
Multifunctional polymer theranostics with enhanced tumor localization and penetration
- 10:30 **B2 Sachin Gupta**  
Cu(O)-RDRP of 2-hydroxyethyl methacrylate in a non-polar solvent: Rapid synthesis of well-defined, high-molecular weight homopolymers and amphiphilic copolymers
- 11:00 **B3 Matěj Vícha**  
Antimikrobiální peptidy

### 11:30 Vyhlášení ceny za nejlepší doktorandskou a post-doktorandskou přednášku

11:45 **PŘESTÁVKA** Oběd

### 13:30 Jak se dělá věda jinde

- 13:30 **C1 Mariya Shamzhy**  
(Charles University, Department of Physical and Macromolecular Chemistry)  
Engineering active sites in zeolite catalysts
- 14:00 **C2 Jana Navrátilová**  
(Univerzita Tomáše Bati ve Zlíně, Ústav inženýrství polymerů)  
Řízená krystalizace izotaktického polypropylenu
- 14:30 **C3 Jaroslav Kučera**  
(ORLEN Unipetrol RPA s.r.o. - POLYMER INSTITUTE BRNO)  
Polyetylen - stále znovu, ale o úroveň výš

15:00 **PŘESTÁVKA** Káva a diskuze u posterů

- 15:30 **C1 Samuel Gallat**  
(Wipak)  
Green Choice by Wipak
- 16:00 **C2 Jan Merna**  
(University of Chemistry and Technology Prague, Department of Polymers)  
Reconsidering terms for basic polymerization mechanisms
- 16:30 **C3 Michaela Rumlová**  
(Vysoká škola chemicko-technologická v Praze, Ústav biotechnologie)  
Sestavení a rozpad retrovirových částic: slibný cíl pro nová antivirotika

17:00 **Zakončení 31. Kolokvia a závěrečné setkání v klubu B a C**

2023

# Seznam posterových prezentací

- P1 Johanna Elter**  
Solid-phase synthesis as a powerful tool for the generation of highly defined, branched polymers
- P2 Olga Gotkiewicz**  
Low-density semi-rigid polyurethane foams based on bio-based polyols
- P3 Anna Hlukhaniuk**  
Magnetic poly( $\epsilon$ -caprolactone)-based and tannic acid-modified nanocomposites for bone regeneration
- P4 Iryna Ivanko**  
Potentiometric detection of reactive oxygen species (ROS) by metalized polyporphyrine layer coated by non-biofouling film
- P5 Konstantin Milakin**  
Phytic acid-containing polyaniline-poly(N-vinylpyrrolidone) cryogels
- P6 Suzana Natourova**  
High-performance protective polyurea coatings based on aspartate esters and bio-based isocyanate
- P7 Ambika Pandey**  
Resistive memory and brain-inspired neuromorphic synaptic plasticity responses of organic unimer and its metalo-supramolecule
- P8 Ewa Pavlova**  
Commonly used vs novel embedding resins for 3D-SEM microscopy with higher resistance to e-beam damage
- P9 Marwa Rebei**  
Ionic liquid-catalyzed step-growth reaction between difunctional epoxy and dicarboxylic compounds
- P10 Oleksandr Shapoval**  
Colloidally stable lanthanide fluorides for biomedical imaging

**31. Kolokvium se uskuteční v přednáškovém sále A, s možností sledovat přenos v klubu B. Posterová sekce bude instalována v galerii Makráč (chodba před kluby B a C).**

Informace o konání Kolokvia 2023 a případné změny v programu lze nalézt na:  
<https://www.imc.cas.cz/events/23kolok/>

**KOLOKVIUM  
2023**



# Abstrakty přednášek

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## A1 **Andres de los Santos Pereira**

### **Grafting density and fouling resistance of poly(HPMA) brushes prepared by “grafting to” and “grafting from”**

Polymer brushes are widely used in biomedical applications to prevent non-specific interactions of surfaces with biological fluids. They are formed when polymer chains are “grafted to” a surface by chemisorption or “grafted from” a surface in a surface-initiated polymerization. Here, we employ RAFT polymerization to prepare poly(HPMA) brushes of comparable molar mass by both methods. While both types of poly(HPMA) brushes substantially reduce fouling from blood plasma, the grafted-from brushes suppress fouling by an order of magnitude better than the grafted-to brushes. This is explained by the much higher grafting density achieved in the grafting from method.

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## A2 **Radoslava Sivkova**

### **Polymer brushes based on *N*-methacryloxysuccinimide as platform for versatile post-polymerization modification**

In this contribution we present a method for the surface-initiated atom-transfer radical polymerization of active esters based on *N*-methacryloxysuccinimide and post-polymerization modification in mild conditions. The obtained active ester brushes show quantitative conversion under amidation conditions with various primary amines, including 1-amino-2-propanol, fluorine containing amines and amine-containing fluorophores. Amidation reaction with propargyl amine offers the possibility to introduce a second functionality in the homopolymer brushes. This widens the ability of polymer analogous reactions with functionalized compounds. The effectiveness of the amidation reaction was deeply studied utilizing spectroscopic ellipsometry, infrared reflection-absorption and X-ray photoelectron spectroscopies, contact angle goniometry and surface energy analysis. As validated by functionalized homopolymer brushes, hierarchical block copolymer brushes containing active ester monomer units also undergo quantitative conversion with primary amines. Furthermore, resulting polymer brushes containing fluorophores were studied by fluorescent microscopy to further investigate their film structure and homogeneity.

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## A3 **Dana Kubies**

### **Polyelectrolyte assemblies for delivery of bioactive proteins supporting cell responses.**

Successful integration of implants and tissue-engineering constructs can be supported by local delivery of growth factors and chemokines stimulating cellular response, which are incorporated into specific coatings or particles. The lecture will give a brief overview of the preparation and physicochemical characterization of several types of polyelectrolyte assemblies in the form of layered-by-layered (LbL) films and nanoparticles, which we have recently designed as platforms for the delivery of heparin-binding growth factors and chemokines.

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#### A4 Małgorzata Świątek

##### Antioxidant-modified magnetic nanoparticles vs. reactive oxygen species

Antioxidants are compounds known for their capability to scavenge reactive oxygen species (ROS), which excessive production is associated with oxidative stress and many diseases, such as diabetes, atherosclerosis, and cancer. The main aim of our study was to gain control over the intracellular level of ROS. For this reason, magnetic nanoparticles were surface-modified with various antioxidants of natural origin. These particles were characterized by enhanced cellular uptake, especially when combined with an external magnetic field, and by the capability to reduce cellular ROS level in a concentration-dependent manner.

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#### A5 Jakub Širc

##### Hydrogel implants for transscleral drug delivery in the treatment of retinoblastoma

Retinoblastoma is the most frequent primary intraocular cancer in the childhood with incidence of 1:17 000 newborns and mortality worldwide about 50%. The treatment of this oncological disease has greatly improved in recent years in terms of survival and eye salvage rates, using mainly intra-arterial or intravitreal chemotherapy. However, the treatment of vitreous tumor seeding still represents a challenge and it is of great interest to develop new strategies to deliver pharmacologically sufficient drug amounts to the vitreous humor. We present a lens-shaped bi-layered hydrogel implant for delivery of topotecan via transscleral diffusion. The implant consists of an inner topotecan loaded poly(2-hydroxyethyl methacrylate) layer adjacent to the sclera and an outer covering poly(2-ethoxyethyl methacrylate) layer impermeable to drug. Topotecan-loaded hydrogel samples exhibit long-lasting *in vitro* cytotoxicity against the Rb cell line Y79. In an *in vivo* experiment on rabbit and pig animal model, bilayered implants were successfully surgically administered to the posterior segment of eyes. The determination of pharmacokinetics demonstrates the attainment of promising levels of topotecan (10 ng/ml) in vitreous humor 8 h after implant placement, together with low drug concentrations in blood plasma. The results from the pilot experiments confirmed the proof of principle for the use of the proposed implants as a drug delivery system for the local treatment of intraocular diseases.

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#### A6 Miroslava Dušková Smrčková

##### Stimuli-responsive hydrogels: External deformation as a trigger. Predicting the phenomenon and struggling for experimental evidence.

The stimuli-responsive (stimuli-sensitive, smart) gels are promising materials capable of a severe while still reversible change of volume (VPT) or appearance (clear-opaque-white). The change is triggered by an external stimulus (temperature, pH, ions, etc.) and is predicted by a TDM model based on the Flory-Huggins-Rehner approach. Recently, we have predicted that the gel response may be triggered by deformation. The model predicts VPT also in the case of simple methacrylate-based hydrogels whose responsivity is not commonly expected. Such effects – if achieved – will lead for example to shape change and loss of transparency and may open door to advanced hydrogel devices.

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## A7 Ondřej Lidický

### Antibody polymer drug conjugates

Combination of monoclonal antibodies as a targeting moiety and *N*-(2-hydroxypropyl methacrylamide) based copolymer loaded with cytostatic drugs creates universal tool for personalized therapy. Tunable drug to antibody ratio and degree of antibody conjugation extend variety of carried cancerostatics and thus enable to syntheses highly efficient nanotherapeutics. First *in vivo* and *in vitro* results were measured on difficult to treat relapsed diffuse large B-cell lymphoma model derived from the relapsed patient.

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## A8 Michaela Hrochová

### One-step synthesis to hydrolytically degradable polymer diblocks

We designed and successfully synthesized four novel chain transfer agents (CTA) for RAFT polymerization. Synthesized CTAs enable the synthesis of hydrolytically labile diblock structures. Differences in CTAs structures control the half-life of the hydrolytic degradation rate of nanomedicine precursors in the range of 5 hours to 21 days. We successfully synthesized polymer conjugates with the antitumor drug pirarubicin attached via a pH-sensitive hydrazone bond. We studied the antitumor efficacy of our conjugates *in vitro* and *in vivo*.

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## A9 Bohumila Podhorská

### Study of the stem cell interaction with biocompatible hydrogel scaffolds designed for tissue engineering

Biocompatible polymer hydrogels based on copolymers of *N*-(2-hydroxypropyl)methacrylamide (HPMA) is suitable material for tissue engineering and regenerative medicine. The aim of the project is the detailed *in vitro* characterization of 3D polymeric scaffolds intended for the reparation of soft tissue and study of rat mesenchymal stem cell (rMSC) interactions with the material.

The hydrogel materials used as scaffolds were modified by RGD oligopeptide motifs or coated by the extracellular matrix protein laminin before the rMSC seeding. Besides appropriate mechanical and biocompatible properties, the scaffolds were designed to be hydrolytically biodegradable. The viability of rMSC seeded on the scaffolds and cytotoxicity of the materials were determined by immunohistochemical methods. Moreover, the distribution and morphology of cells growing on hydrogels were observed by laser scanning confocal microscopy (LSCM).

The output of the study is important for developing the novel suitable scaffolds in terms of the material structure, surface modification, biocompatibility, biodegradability, and overall behavior in physiological solutions.

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## A10 Richard Laga

### Bio-responsive polymer probes for X-nuclei magnetic resonance spectroscopy imaging

Magnetic resonance spectroscopy imaging (MRSI) of X-nuclei (e.g. <sup>31</sup>P, <sup>19</sup>F) is a modern diagnostic technique that allows visualization of internal body structures and monitoring of physiological processes *in vivo*. Despite its great potential, X-nuclei MRSI is not widely used in clinical practice, mainly due to the unavailability of suitable exogenous probes. Therefore, we focused on the development of biocompatible <sup>31</sup>P/<sup>19</sup>F MR probes based on bio-responsive phosphorus- and/or fluorine-containing polymer zwitterions. We showed that the prepared probes provide a high-intensity MR signal distinct from the biological background and have relaxation times satisfying clinical requirements.

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## A11 Diana Oleshchuk

### Nanogels from biocompatible polymer precursors

In the work, we prepared biocompatible nanogels from polyglutamine and zwitterionic polyaspartamides precursors by horseradish peroxidase/H<sub>2</sub>O<sub>2</sub>-catalyzed crosslinking in an inverse miniemulsion. We studied the effect of surfactants on the properties of the final nanogels, stimuli-responsive behavior of the nanogels, *in vivo* biodistribution, and blood clearance of the polyglutamine nanogel. Finally, we examined the loading and release of model protein albumin and protease inhibitor  $\alpha$ 1-antitrypsin with both nanogels to inhibit serine protease trypsin.

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## A12 Martina Vragovic

### Responsive polymer-lipid hybrid giant vesicles

Recently, there has been a growing interest in the formation of polymer-lipid hybrid self-assemblies (herein named, hVS), which allow combining and improving the main features of pure lipid-based and copolymer-based assemblies known for their potential applications in the biomedical field. We present a monodisperse pH-responsive giant. Several lipids/polymer ratios were tested using the pH-responsive homopolymer poly[2-(diisopropylamino) ethyl methacrylate]-synthesized by reversible addition-fragmentation chain-transfer (RAFT) polymerization post-conjugated to cholesterol and used in combination with poly(1,2-butadiene)-*b*-poly(ethylene oxide).

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## A13 Volodymyr Lobaz

### Synthetic polymers in physiological media: The isothermal titration calorimetry study

Polymers, when applied *in vivo* undergo numerous interactions with biopolymers and surfaces, which influence their pharmacokinetics and biodistribution. The isothermal titration calorimetry shed the light on the mechanism of such interactions.

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## A14 Zulfiya Černochová

### Supramolecular melittin encapsulation by tuned charge compensation with polymer carriers

Protein venoms of certain insects are of high interest as potential active pharmacological ingredients due to their wide availability and yet poor number of clinical studies. In this talk, we describe an extremely efficient platform for the encapsulation of cationic amphiphilic animal venoms such as a poison melittin. The idea is based on supramolecular charge compensation with nanoparticles (NPs) composed of hydrophobic glassy polystyrene core and hydrophilic poly(meth)acrylic acid nanodomains with high anion charge density at physiological pH. Instant “mix and go” process and melittin encapsulation in concentrations of NPs as low as mg/ml was proven by inhibition of melittin-induced hemolysis.

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## A15 Vladimir Sincari

### Stimuli-responsive self-assembled polymer systems for drug delivery

The presented study is devoted to delivery of therapeutic molecules by using cargo-delivery self-assemblies in the form of polymersomes (PS). Such drug delivery systems (DDS) potentially minimize the premature degradation of drug, fast clearance from bloodstream and dosing frequency which leads to lower toxicity. The main advantage of DDS is the controlled manner of drug release at a specific site via active or passive targeting strategies. Passive targeting is a preferential accumulation of nanocarriers (NCs) in tumor tissue based on pathophysiological features (i.e., leaky tumor vasculature and poor lymphatic drainage) of the growing solid tumor. For passive targeting, suitable particles size (from 10–100nm), surface charge and surface modification can promote effective extravasation as well as reduced liver capture and renal clearance. Active targeting refers to ligands' affiliation to receptors or with physicochemical engineering of structure for recognition by specific antigen/receptor of targeting cell. More novel stimuli-responsive programmed specific targeting in combination with previously mentioned strategies could achieve higher accumulation in tumor and enhance cellular internalization. Microfluidics was used in the preparation of well-defined stimuli-responsive PSs.

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## A16 Vladimír Raus

### Synthesis of complex polymeric architectures via Cu-RDRP initiated by the adducts of trichloroacetyl isocyanate

A novel strategy for preparing complex polymeric architectures is introduced, utilizing Cu-RDRP initiated by the adducts of trichloroacetyl isocyanate (TAI). TAI reacts rapidly and cleanly with a range of functionalities, introducing the trichloroacetyl initiation sites into a variety of substrates. Using the TAI/methanol adduct as a model initiator, we identified conditions for well-controlled Cu(0)- and/or Cu(I)-catalyzed Cu-RDRP of a range of different monomers. Importantly, we showed that the TAI-based initiation sites can act as trifunctional, which enables the synthesis of novel architectures. Finally, we demonstrate the utility of the TAI-based initiators in various scenarios.

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## A17 Rafał Poreba

### Surface-initiated controlled polymerization of (meth)acrylamides for advanced biointerfaces

In this contribution, we will present novel and facile strategies for the synthesis of antifouling and highly stable poly(HPMA) and poly(CBMAA) brushes from silicon and polydimethylsiloxane (PDMS) surfaces via SI-ATRP, interface-mediated RAFT and photoinduced RAFT polymerization techniques. In addition, utility of these new approaches for the modification of PDMS-based microfluidic devices and bulk material will also be presented. The evaluation of the viability of the developed methodology for the modification of PDMS surfaces and the presence of poly(HPMA) brushes on the adhesion of NIH 3T3 cells and *S. aureus* and *E. coli* bacteria will also be shown.

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## A18 **Věra Cimrová**

### **Formamidinium lead iodide perovskite thin films and interesting hybrid layers of conjugated copolymers for photonics**

Organic-inorganic perovskites and conjugated polymers are very promising materials for various photonic applications. Thin films made of formamidinium lead iodide (FAPbI<sub>3</sub>) perovskites prepared by a two-step sequential deposition method using various solvents for formamidinium iodide are reported. The correlation between morphology and solvent properties is discussed. The study provides insight into FAPbI<sub>3</sub> film fabrication with large grains. Further, preparation and properties of hybrid layers of perylenetetracarboxydiimide-based copolymers with silver nanoparticles are reported and discussed in relation to the copolymer structure.

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## A19 **Yadu Ram Panthi**

### **Memristors for emerging organic memory devices and neuromorphic computing**

The exponential growth of electronics and computing has sparked interest in alternative electronic components. One promising technology are memristors. Memristor is a two-terminal, sub-nanometer structure that can dynamically reconfigure its resistance through electrical stimulation. It has the potential to revolutionize high-density data integration and storage by biologically-inspired on-chip memory storage and in-memory computing with low energy consumption. Our research has focused on studying the memristive effect in various organic materials, including small molecules, metal complexes, and polymers, with the goal to verify their potential use for data storage and neuromorphic computing

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## A20 **Jiří Czernek**

### **On the C–H...O interchain interactions in polymers**

An importance of weak C–H...O interactions for the stabilization of supramolecules has been recognized several decades ago. However, only recently it has become possible to routinely apply highly accurate quantum chemical methods to sufficiently large (comprising around 100 atoms; see 10.3390/ijms232415773) molecular fragments to obtain a quantitative description of factors contributing to the intermolecular stabilization that possibly includes the C–H...O contacts. Results will be presented of related analysis of models of solid phases of poly( $\epsilon$ -caprolactone). This research contributes to molecular-level understanding of some physical properties of polymers like the crystallinity and melting.

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## A21 **Ivana Šeděnková**

### **Influence of oxidant on the photoacoustic response of polypyrrole nanoparticles / Presentation of Renishaw inVia Qontor Raman Microspectrometer**

The photoacoustic response of polypyrrole particles was studied in relation to the type and amount of oxidant used. A detailed study of the molecular structure of these particles was performed using infrared and Raman spectroscopy. The particles prepared using superstoichiometric amounts of the oxidizer, nPy:nOxi = 1:3, in the case of iron(III) chloride and stoichiometric nPy:nOxi = 1:1, in the case of APS - showed the best photoacoustic output.

The second part of the lecture will be dedicated to the presentation of the new inVia™ Qontor™ confocal Raman microscope installed in the lab 409 in November 2022.

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## **A22 Doebner von Tumacder**

### **Electrochemical properties of polypyrrole films prepared in the presence of organic dyes**

This work describes facile preparation of electrosynthesized PPy-safranin and PPy-AcidBlue25 films and its electrochemical properties. Cauliflower-like structures is obtained for PPy-safranin films while fibrillar morphology is observed for PPy-AcidBlue25. Safranin and Acid Blue 25 increased the electroactivity of PPy. PPy-AcidBlue25 has the highest capacitance which was approximately 10 times higher than pristine PPy. The electrochemical stability of PPy has improved to 89% and 99% in the presence of Acid Blue 25 and safranin, respectively. The presence of organic dyes in PPy results in promising electrochemical performance which can be highly beneficial in energy storage devices.

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## **A23 Miroslav Otmar**

### **Chiral selective membranes for the separation of racemic mixtures**

Cost-effective production of enantiomerically pure compounds is still a challenging task, despite the great progress in asymmetric syntheses, fermentation procedures and chiral separation techniques. Membrane-based chiral separation is a recently emerged new technique, which seems to be one of the adequate responses to this demand. The preparation of polystyrene-block-poly(ethylene-ran-butylene)-block-polystyrene (PSEBS) membranes bearing covalently anchored chiral selectors and their use for an enantiomeric enrichment of racemic compounds will be presented.

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## **A24 Adam Strachota**

### **Self-Healing and Super-Elastomeric PolyMEA-co-SMA Nanocomposites Crosslinked by Clay Platelets**

Tough and self-healing super-extensible elastomers (dry ones, not gels) based on poly(methoxyethyl acrylate)/clay nanocomposites, doped by sodium methacrylate (SMA) were prepared. Great improvement in autonomous self-healing, and also a tremendous increase in tensile strength and toughness was due to the ionic SMA. The mechanism of the SMA effect was elucidated: the formation of dynamic multiplets of SMA units (nano-aggregates). The design can be useful for solvent-free self healing materials.

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## **A25 Miroslav Šlouf**

### **Micromechanical properties: Our contribution to Encyclopedia of Polymer Science and Technology**

The presentation will introduce our contribution to prestigious Encyclopedia of Polymer Science and Technology. The Encyclopedia presents over 500 articles, written by specialist all over the world. The contributions are based on personal invitation. Our invited contribution covers the field of micromechanical properties. This is a great success, considering that the key device – the instrumented microindentation hardness tester – was installed at IMC at the end of 2013. We will revise the history of micromechanical measurements at IMC, explain how we managed to become experts in the field within 8 years, and summarize the advantages of micromechanical characterization of polymers.

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## A26 Zdeněk Starý

### Fused filament fabrication of beta-nucleated polypropylene

Fused filament fabrication (FFF) is an emerging technology of 3D printing. However, printed parts have lower mechanical performance when compared with injection moulded parts and the portfolio of printable polymers is still limited to amorphous or low-crystalline ones. Contrary to that, the use of polypropylene materials in FFF faces considerable challenges such as high internal stress, which results in warping and shape distortion of the printed parts. Thus, the internal structure of polypropylene and its development play crucial role in FFF of polypropylene. The contribution summarizes first findings focused on basic structure-properties relationships in FFF of beta-nucleated PP.

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## A27 Kateřina Skleničková

### Biodegradation of aliphatic polyurethane foams in soil and effect on microbial population development

We have studied biodegradability of fully aliphatic polyurethane (PU) foams in soil environment. Two types of PU foams with different chemical composition, supramolecular structure and cellular morphology were prepared. These PU foams were degraded using a six-month soil burial test. During biodegradation experiments, CO<sub>2</sub> evolution, enzyme activities (proteases, esterases and ureases) and microbial population composition of bacteria and fungi were analysed (16S rRNA gene and ITS2 region sequencing, PLFA analysis). The PUR foams were mineralized from 30–50 % and microbiological analysis did not show any significant changes in the composition of the microbial population during biodegradation of PUR foams.

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## A28 Ehsan Naderi Kalali

### Eco-friendly and bio-based flame-retardant treatment of cotton fabric by a one-pot ultra-fast deposition approach

Sol-gel techniques are straightforward and diverse approaches to develop flame retardant coatings with tailor-made properties. The sol-gel process is used to deposit the functional coating directly on the surface of the cellulose skeleton of the cotton fabric. One-pot deposition of sol showed great capability in the formation of a continuous, transparent, uniform, stable, and flexible film on the surface of cotton fibers via a hydrogen bond. The coating provides great fire safety through synergistic effects in combination with phosphorus/nitrogen-containing compounds.

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## A29 Hynek Benes

### Ionic liquid-mediated epoxy ring opening: Dual curing or fake news?

Ionic liquids, thanks to their diverse chemical structure and ionic character, enable to initiate / catalyse a number of chemical reactions, including polymerizations. In this contribution, we study oxirane ring opening polymerization mediated by imidazolium, phosphonium and metal-containing ionic liquids. The simultaneous presence of anions and cations can lead to different activation mechanism of polymerization and the formation of structurally different polymer networks.

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## Ocenění pracovníci

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### B1 Eliška Grosmanová

#### Multifunctional polymer theranostics with enhanced tumor localization and penetration

Water-soluble biocompatible polymers based on *N*-(2-hydroxypropyl) methacrylamide enable the attachment of numerous active molecules along the chain. The attachment of targeting oligopeptides enables targeting to specific receptors overexpressed on tumor cells, resulting in reduced side effects of therapy as well as a fluorescent visualization. In addition, cell-penetrating peptides attached to the polymer backbone promote a rapid transport of theranostics into the intracellular space. The proposed theranostics containing the aforementioned oligopeptides in addition to a suitable cytostatic and fluorescent dye can serve as multifunctional molecules for visualization and treatment of tumors.

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### B2 Sachin Gupta

#### Cu(0)-RDRP of 2-hydroxyethyl methacrylate in a non-polar solvent: Rapid synthesis of well-defined, high-molecular weight homopolymers and amphiphilic copolymers

A rapid and well-controlled method for (co)polymerization of HEMA via metallic copper-mediated reversible-deactivation radical polymerization (Cu(0)-RDRP) in a non-polar solvent (1,4-dioxane) using a chlorine-based initiation/catalytic system is demonstrated. The protocol affords very well-defined ( $\bar{D} \leq 1.26$ ) HEMA homopolymers in an unprecedentedly wide range of molecular weights from 5 000 to 500 000. The utility of using a non-polar medium is exemplified by copolymerizing HEMA with an equimolar amount of a lipophilic comonomer, 2-ethylhexyl methacrylate or lauryl methacrylate, yielding well-defined amphiphilic copolymers, thereby expanding the application scope of the HEMA monomer.

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### B3 Matěj Vícha

#### Antimikrobiální peptidy

Rozvoj multirezistentních bakteriálních kmenů představuje riziko pro současnou léčbu bakteriálních infekcí a může výrazně omezit jejich terapeutické možnosti. Při léčbě infektů způsobených takovými kmeny se může prokázat standardní terapie jako neefektivní a léčba často pokračuje alternativní cestou, která může způsobit další zdravotní rizika. Ke zmírnění dopadů antibiotické rezistence je tedy třeba objevit nové antimikrobiální látky. Tato práce se věnuje antimikrobiálním peptidům, což jsou potenciálně vhodní kandidáti, jejich syntéze a biologickým testům. Pro jejich využití *in vivo* byl také připraven a otestován dopravní systém na bázi polymerního nosiče.

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## Jak se dělá věda jinde

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### C1 **Mariya Shamzhy** (Charles University, Department of Physical and Macromolecular Chemistry)

#### Engineering active sites in zeolite catalysts

As one of the most important heterogeneous catalysts, zeolites have found application in a number of large-scale processes that require active sites of different nature. This contribution will address recent developments in tailoring active sites in zeolites for industrially relevant acid-catalyzed and redox reactions. Special attention is paid to two key ways of zeolite design for a particular type of transformation: 1) isomorphous substitution of different three- and four-valent elements in a zeolite framework and 2) stabilization of size-controlled small metal clusters and nanoparticles through their encapsulation in the voids of a zeolite.

### C2 **Jana Navrátilová** (Univerzita Tomáše Bati ve Zlíně, Ústav inženýrství polymerů)

#### Řízená krystalizace izotaktického polypropylenu

Nadmolekulární struktura izotaktického polypropylenu (iPP) se odvíjí od strukturních parametrů řetězců jako molární hmotnost, linearita či začlenění komonomeru, ale zásadní jsou také krystalizační podmínky, např. teplota, tlak, použití nukleačních činidel či jiných přísad. Vzhledem k polymorfní povaze iPP a pomalé krystalizaci se nabízí také využití rekrystalizačních procesů. Větvení polypropylenu (LCB-PP) vede nejen ke zvýšení elongační viskozity, ale značně ovlivňuje krystalizaci. LCB-PP má zvýšenou tendenci krystalizovat do gama-fáze a naopak potlačuje účinnost beta-nukleačních činidel, a to i v případě použití směsí pouze s 1 hm. % větveného polypropylenu v lineárním. V čistém LCB-PP i ve směsích s lineárním iPP pak dochází ke zrychlení krystalizace díky samonukleačnímu efektu.

### C3 **Jaroslav Kučera** (ORLEN Unipetrol RPA s.r.o. - POLYMER INSTITUTE BRNO)

#### Polyetylen - stále znovu, ale o úroveň výš

Příspěvek se týká bimodálního polyetyleny (PE), který produkuje jednotka PE3 (300 kt/rok, 2019, ORLEN Unipetrol RPA, s.r.o.). Pro tuto jednotku zajišťuje PIB servis a částečnou kontrolu kvality i aplikací. Dále řeší otázky polymerace a specifických vlastností, především životnosti. V příspěvku budou uvedeny informace o polymeračních reaktorech, které byly vyvinuty v PIB a které umožňují řídit i sledovat polymeraci. Životnost se hodnotí tzv. urychlenými testy: Full Notch Creep Test (ISO 16770), Cracked Round Bar (ISO 18489), Strain Hardening test (ISO 18488). V příspěvku budou zmíněny některé kritické experimentální problémy, uvedeny rozdíly mezi typy PE a diskutován vliv vnějších podmínek.

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## C4 **Samuel Gallat** **(Wipak)**

### **Green Choice by Wipak**

Part of the family-owned Finland based Wihuri Group, Wipak has more than 40 years of experience in manufacturing, specialising in multilayer films for food packaging and medical products. GreenChoice by Wipak is a comprehensive product portfolio designed to make sustainability in flexible packaging as easy as possible.

It consists of three basic approaches:

**Renewable:** Paper based solutions and new plastics made from renewable feedstock. The paper share of 60% allows for disposal and recycling via the paper bin in several EU-countries.

**Recyclable:** Solutions aligned with recycling guidelines and designed for a circular economy. Recyclable means that the packaging has a realistic chance to be collected, sorted and recycled into a new material at scale, in a given country or market.

**Recycled:** Integrating mechanically or chemically recycled raw materials into the packaging.

For each approach there will be several practical examples from current product portfolio.

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## C5 **Jan Merna** **(University of Chemistry and Technology Prague, Department of Polymers)**

### **Reconsidering terms for basic polymerization mechanisms**

Many of us use terms “chain-growth polymerization” and “step-growth polymerization” to classify the two basic polymerization mechanisms, even though IUPAC never endorsed the use of them. Last IUPAC recommendation from 1994 uses term non-chain polymerization as an umbrella term for polycondensation and polyaddition. The aim of this talk is to stimulate a discussion in order to find accurate and attractive term for this group of polymerizations.

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## C6 **Michaela Rumlová** **(Vysoká škola chemicko-technologická v Praze, Ústav biotechnologie)**

### **Sestavení a rozpad retrovirových částic: slibný cíl pro nová antivirotika**

Retroviry během svého replikačního cyklu musí sestavit dva typy částic: nejprve tu – tak zvaně – nezralou – tedy neinfekční, sestavenou v buňce z dlouhých polyproteinových prekursorů a genomové RNA, a poté, co opustí buňku, dochází díky štěpení polyproteinů na funkční proteiny k velké reorganizaci a znovu-sestavení maturního, plně infekčního virionu. Pro porozumění mechanismů vedoucích k tvorbě obou typů částic jsme zavedli zjednodušující „*in vitro*“ metody sestavování virových částic. Tato metodika nám umožňuje nejen strukturně-funkční charakteristiku proteinových domén, zodpovědných za sestavování obou typů částic, ale také testování malých molekul ovlivňujících tyto procesy.

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