Wydział Chemii

PPNT
Poznan Science
and Technology Park

Ministry of Education and Science
Republic of Poland

RESEARCH
UNIVERSITY
EXCELLENCE INITIATIVE

BOOK OF ABSTRACTS

2ND SYMPOSIUM ON POLYDOPAMINE

under Honorary Patronage of the
Rector of the Adam Mickiewicz University,
and Polish Chemical Society

October 11–12, 2023
Poznań
Poland

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Project co-financed by the state budget, granted by the Polish Minister of Education and Science under the Program "Excellent Science II - Support for scientific conferences"

Conference partners

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im. Adama Mickiewicza

UAM Wydział Chemii

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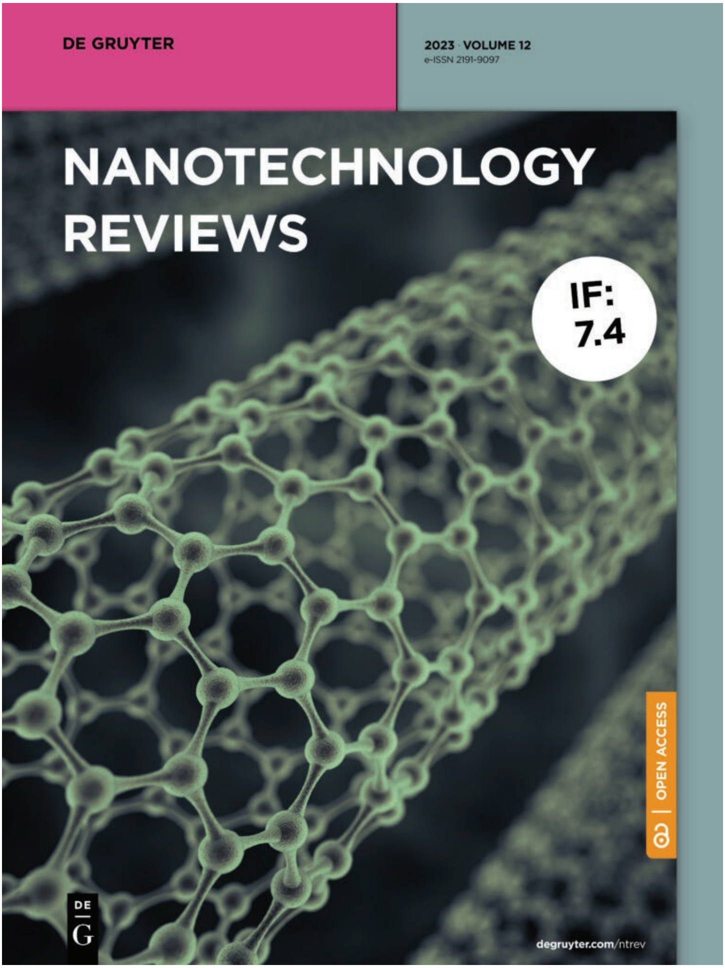
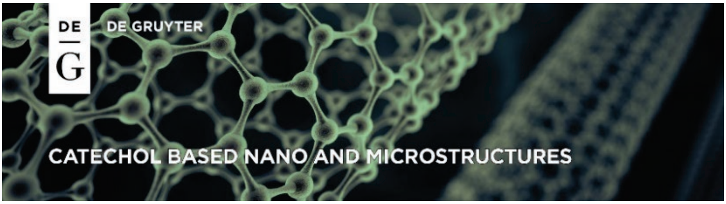
Media partner

DE GRUYTER



2nd Symposium on Polydopamine



Unique publication opportunity for participants

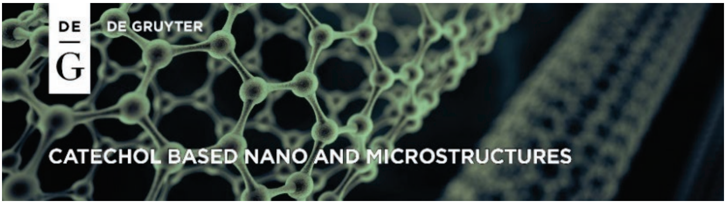
DESCRIPTION

The 2nd Symposium on Polydopamine is a unique conference dedicated to the latest developments in the rapidly growing field of materials chemistry, biomaterials and polymers and their applications in medicine, catalysis, and energy generation/storage. The flagship catechol material that has found application in the aforementioned areas is polydopamine. Hence it is also in the name of the conference. However, the group of catechol materials grows more and more each year. Therefore, the Symposium is a response to the expectations of the scientific community working in catechol chemistry on the creation of a place for the exchange of ideas and experience in this topic. The conference will bring together distinguished plenary lecturers - specialists in the subject from Europe (Poland, Spain, Germany, Portugal, France), China, the USA and South Korea, who have unquestionable scientific achievements. This special issue will be related to the 2nd Symposium on polydopamine. A unique international conference that gathers high-top researchers from Europa and Asia in the field of catechol-based materials. The issue will collect high-quality papers related to the applicationof materials on nano/microscale based on polydopamine and related catechol according to the topic listed in the next paragraph. We believe we can collect 8-10 papers that will be submitted by the most prominent scientists from the field of catechol chemistry, engineering, and their biomedical application. Thus, the special issue will draw the attention of readers across different disciplines. The Nanotechnology Reviews is a perfect forum to disseminate results from researchers participating in the symposium since it is a top journal in nanotechnology and perfectly aligned with the quality of research presented during conferences. Moreover, the journal's scope fits the conference's scope as well. We believe that cooperation will bring benefits to the conference, as well as will promote the Nanotechnology Reviews allowing its further growth.

Topics include, but are not limited to application of catechol-based nano/micromaterials in

- Nano/microstructures synthesis
- Nanomedicine
- Biomedical Science
- Engineering
- Biomedical engineering
- Environmental sciences
- Biotechnology
- Energy
- 2D and 3D structures synthesis and characterization
- Modification at nanoscale
- Coatings
- Chemistry of catechol related materials

2nd Symposium on Polydopamine



GUEST EDITORS

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PUBLICATION SCHEDULE / HOW TO SUBMIT

Open for submissions: 1st September 2023
Paper submission deadline: 31th December 2023

When entering your submission please choose the option type of an article: "Catechol based nano and microstructures" Submissions for the special issue are now open. In case of any technical problems, please contact the Managing Editor of Nanotechnology Reviews:
Juliusz Skoryna, Ph.D.,
Juliusz.Skoryna@degruyter.com

INFORMATIONS

Venue

Adam Mickiewicz University in Poznań
Faculty of Chemistry
Uniwersytetu Poznańskiego 8, 61-614 Poznań
Lectures will be held in the room 2.57

Date

11-12 October 2023

Conference Language

The lectures and posters will be presented in English.

Registration

The Registration Desk will be open during the following hours:
11 October – 8:00 AM – 10:00 AM
12 October – 8:30 AM – 9:30 AM
Please be prepared to present your ID and, if applicable, a proof of your student status.

Name Badge

Participants, accompanying persons and exhibitors are kindly requested to wear their name badge during all conference events. Lost badges will be replaced at the Registration Desk upon presentation of an identity card.

Certificates of Participation

Certificates of Participation will be issued together with the conference package.

Internet access

The Eduroam network will be active in the building for the duration of the conference.
More information about this network and logging is available at these links:
https://eduroam.org/ https://www.eduroam.pl/

Catering

Free lunches and soft drinks will be offered to all participants during Lunch Breaks at the catering area. Tea and coffee will be available free of charge in the morning and in the afternoon during Coffee Breaks.

Hotel Accommodation

For the highest convenience and your comfort, we recommend a Hotel Mercure Poznan Centrum which is located in the beautiful city center from where there is excellent access by tram to the conference venue.

Hotel Mercure Poznan Centrum offers special prices for Symposium Guests. If you are interested in this hotel, contact the Organizers for a password to book the hotel at a lower price. The number of places is limited.

Hotel Mercure Poznan Centrum

Adress: Roosevelta 20, 60-829 Poznań
Tel. +48 61 8558000
E-mail: h3393-re@accor.com

Other recommended hotels:

ILONN HOTEL

Adress: Szarych Szeregów 16, 60-462 Poznań
Tel. +48 61 6687575 / +48 668 897 575
E-mail: rezerwacja@ilonnhotel.pl

HL HOTEL LECHICKA

Adress: Lechicka 101 61-619 Poznań
Tel. +48 697 900 213
E-mail: recepcja@hotel-lechicka.pl

HOTEL FORZA

Adress: Dworska 1, 61 – 619 Poznań
Tel. +48 61 8213666
E-mail: recepcja@hotelforza.pl

Transfer from Poznań-Ławica airport

Poznań-Ławica Airport is connected to the city center by public transport. Bus stops are located in the immediate vicinity of passenger terminals, or in a short distance from them.

The easiest way to get to the city center is to take the city bus no. 159, which departs from the Ławica Airport stop and passes through the Rondo Kaponiera stop, which is the largest public transport transfer center in the city. At the airport, you can buy public transport tickets at a kiosk or at a ticket machine.

At the airport there is also a taxi stand and car rental.

https://poznanairport.pl/en/before-the-trip/access-to-the-airport/

Move around the city

The Faculty of Chemistry owns an outdoor parking lot (free of charge) but we recommend using public transport. The Morasko campus where the Faculty of Chemistry is located is at the end of the PST fast tram route that leads from the train station, through the city center straight to the campus.

For planning a trip by public transport please visit official page page: https://www.ztm.poznan.pl/en/rozklad-jazdy/ or use free app which contains the current timetables of public transport along with the maps. The app is available in English. If you allow it to use your location, it can show you the best connection from wherever you are.
You can use the application free of charge on the website: https://jakdojade.pl/poznan/ or download if directly from your app store (Google Play, App Store, Huawei Appgallery).

Buses and trams have a unified system of one-way tickets, for those visiting Poznań, single-time paper tickets will be the most convenient. A time ticket entitles to an unlimited number of journeys in a period not longer than 15, 45 or 90 minutes since it was validated, with as many changes of lines as necessary. The time-limit ticket entitles users to travel on all ZTM lines, i.e., by bus (city or suburban) or tram.

During the first journey the ticket should be validated immediately after boarding the vehicle. After validation, the time ticket remains valid throughout the number of minutes indicated by its nominal value. Real time of the journey is measured.

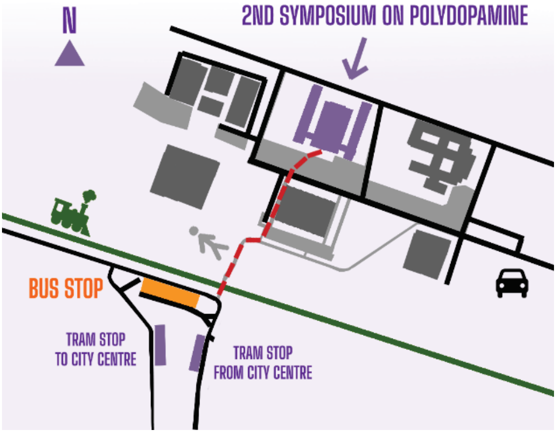
ZTM offers the following types of time tickets:
15-minute which costs 4 zł (0,9 EUR)
45-minute which costs 6 zł (1,34 EUR)
90-minute which costs 8 zł (1,79 EUR)

Single, time-tickets are also available through mobile apps: MoBilet www.mobilet.pl, mPay (www.mpay.pl), SkyCash (www.skycash.pl), GoPay (GoPay) and jakdojade.pl (www.jakdojade.pl)

TAXI in Poznań

Available taxis can be found on the website: https://www.poznan.pl/mim/main/taxi,poi,116,6142/
You can also use Uber and Bolt services. Companies performing transport using the application are registered in Poland in the same way as taxis and each vehicle of this type should be marked as TAXI.

How to get from public transport to the venue



The map above shows the route that needs to be taken from the fast tram/bus stop to the building of the chemistry department where the conference is held.

Venue address:

ul. Uniwersytetu Poznańskiego 8
61-614 Poznań

Alternatively, here you can find a link to Google maps pinned to venue location:
https://goo.gl/maps/PyCZKLc2fHsBtqQE6

Currency

The currency in Poland is Polish zloty (PLN), 1 zloty is worth approximately 0,22 euros. Currency exchange offices are located both at the airport, the railway station and in the city center. Most shops, restaurants and vending machines accept payment (also contactless) with VISA and MasterCard cards.

Welcome note by the Dean of Faculty of Chemistry AMU

Ladies and Gentlemen,
Dear Colleagues,

Welcome to Poland! Welcome to Poznań!

It is my great honor and privilege to welcome you to Faculty of Chemistry, Adam Mickiewicz University, host of the 2nd Symposium on Polydopamine. There are moments, where one can feel how good is to be a dean...

Few words about our city - I really do hope you will have time (organizers certainly will take care of this) to visit the most important historical sites here... Poznań is one of the oldest cities in Poland, and one of the few most important ones. Here, at this very place on the banks of Warta river, the Poland as a country was born more than thousand years ago. The academic tradition of Poznań dates back to the beginning of the 17th century, when the first educational institutions of the university rank were established here. Since then, with breaks resulting from the turbulent history of this part of Europe, scholars and students have been a permanent component of the Poznan community. The contemporary history of academic Poznan begins after the First World War, after Poland regained its independence which was lost for more than 100 years. We, the university, community
of scholars and students devoted to search the truth regardless on the outside world, are still developing Our new Campus Morasko, including new Collegium Chemicum, where this meeting is held, is a good example of that.

Thanks for attending 2nd Symposium on Polydopamine, thanks for visiting Faculty of Chemistry, Adam Mickiewicz University, thanks for visiting Poznan. I am sure that these few days will be a time of fruitful exchange of thoughts, new ideas and new contacts,
as well as getting to know this very special, beautiful part of Poland.

Maciej Kubicki

Dean and Professor, Faculty of Chemistry

Welcome note by the Conference Chair

Dear Catechol Colleagues,

Welcome to the 2nd Symposium on Polydopamine, Welcome to Poland.

The 2nd symposium on polydopamine is a continuation of the conference's first edition started in 2018 in Poznań. Polydopamine has become the flagship catechol material from which the Renaissance of catechol materials began. Hence, the polydopamine is in the name of the conference. However, the group of catechol materials grows more and more each year, and they have found applications in various branches of sciences, including catalysis, energy storage and production, medicine, nanotechnology, polymer chemistry, environmental sciences, and adhesion. Therefore, the symposium is a response to the expectations of the scientific community working in catechol chemistry on setting a place to exchange ideas and experience in these topics where catechols are crucial building blocks. I believe that our conference will be a leading forum in the area of catechol-based materials and chemistry in the near future. The future that we will build together.

We meet in Poznan. It is one of the most important cities in Poland from both historical and economic points of view. Poznan is the capital of the Greater Poland Region, which will charm you with the Warta River, lakes, beautiful forests, and historic mansions. You will find many tourist places worth seeing here and many attractions to relax after the conference meeting. Poznan is a city with a long academic tradition. I would like to recall the Lubrański Academy established in 1520, and my University – Adam Mickiewicz University, which originates from Poznań University that was founded in 1919 after regaining independence from the Polish Nation in 1918. The University changed its name to Adam Mickiewicz University in 1955. Adam Mickiewicz University together with other Universities present in Poznań makes it one of Poland's most important academic centres.

I wish you all fruitful deliberations that will inspire you for further scientific work and bring success to our conference!

Radosław Mrówczyński

Conference schedule

Wednesday 11.10.2023

8:00-9:00	REGISTRATION
9:00-9:30	OPENING CEREMONY
9:30-10:15	Daniel Ruiz-Molina “Catechol-Based Nanostructures In Medicine”
10:15-11:00	Tomasz Ciach “Oxidative Polymerization Of Various Phenylamines For Medical Coatings”
11:00-11:30	COFFEE BREAK
11:30-12:15	Anna Belcarz “Natural Polymers - Matrices for Polycatecholamine Coating”
12:15-13:00	Radosław Mrówczyński “Chemistry of Nanoscale Polydopamine-Based Materials”
13:00-14:00	LUNCH
14:00-14:30	GROUP PHOTO
14:30-15:15	Vincent Ball “Oxidized Dopamine, Polyphenols and Aminomalononitrile: From Functional Hydrogels to Graphene Oxide Like Materials”
15:15-16:00	Maria Laura Alfieri “Novel Strategies for Polydopamine Site-Specific Deposition and Catechols/Diamines Bioactive Coatings Implementation”
16:00-16:45	Cordelia Zimmerer “Polydopamine-Mediated Materials Adhesion of Plastics and Metal – Key To Ecofriendly Material Design And Processing”
16:45-17:00	BREAK
17:00-18:00	POSTER SESSION
18:00-21:30	GALA DINNER

Conference schedule
Thursday 12.10.2023

9:00-9:45	Jürgen Liebscher "Modifying The Structure Of Dopamine – Consequences To Polymer Formation"
9:45-10:30	Emerson Coy "Possible Supramolecular Ordering in Polydopamine Film"
10:30-11:00	COFFEE BREAK
11:00-11:45	Christopher V. Synatschke "Ultrathin Films And Self-Standing Membranes From Polydopamine: A New Material For Photocatalysis, Biosensors, And Water Filtration "
11:45-12:30	Bartłomiej Graczykowski "Mechanical And Thermal Engineering Of Functional Nanomembranes"
12:30-13:15	Yeonho Kim "Design Of Polydopamine-Semiconductor Nanocomposites For Energy Application"
13:15-14:15	LUNCH
14:15-14:45	CLOSING CEROMONY

Conference organizers

Adam Mickiewicz University in Poznań

Adam Mickiewicz University is the major academic institution in Poznań and one of the top Polish universities. Its reputation is founded on tradition, the outstanding achievements of the faculty and the attractive curriculum. The mission of the University is to advance knowledge through high quality research and teaching in partnership with business, professions, public services and other research and learning providers.

History of AMU

The history of the university in Poznań begins in the 16th century when in 1519 a Roman-Catholic Bishop Jan Lubrański founded the first Academy in town, which back then boasted the status of a higher learning institution. Shortly after, another institution of higher learning – the Jesuit College (1573) - was established in Poznań. Its first Rector, Jakub Wujek, was the author of the main Bible translation into Polish. On October 28th, 1611, King Sigismund III Vasa granted the Jesuit College the status of the first University-type school in Poznań. The privilege was re-affirmed by King John III Sobieski and the University in Poznan functioned until 1773.

In the following turbulent years of Polish history, science and higher education were always vibrant in Poznań. The key role in their development was played by the Poznań Society of Friends of Sciences which preserved the academic legacy forward in partitioned Poland (1795-1918) until the official re-establishment of the University of Poznan, following the end of the First World War, in 1919.

Ever since, the University of Poznań has flourished, and only one more time was it forced to go underground and provide its services in conspiracy during the Second World War under the name of clandestine University of the Western Lands (1940-1944). Despite the Nazi German occupation it managed to educate and produce over 2,000 graduates with the help of some 300 academic teachers, who risked their lives by offering university courses in Polish, which was made illegal during the war.

In 1955 the University was granted the name of a new patron - Adam Mickiewicz, ushering in the modern era. To learn more about Adam Mickiewicz, click here.

In 2019 Adam Mickiewicz University celebrated its 100th Anniversary together with three other schools formed following the split of the University of Poznan into four independent higher educational institutions: Adam Mickiewicz University (AMU), Poznan University of Medical Sciences (PUMS), Poznań University of Life Sciences (PULS) and Poznań University of Physical Education (PUPE).

AMU today

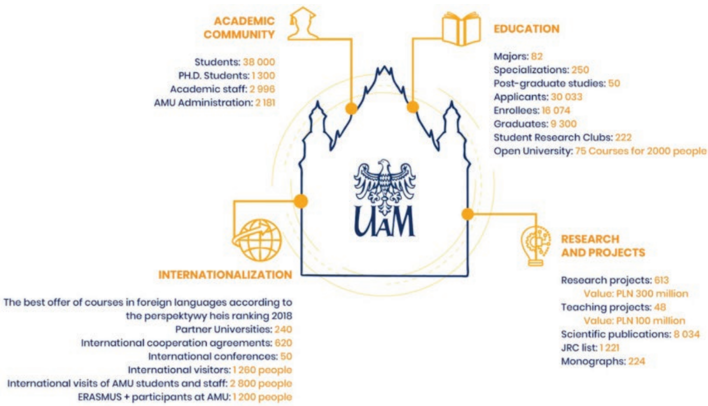
The university, aware of its rich traditions of excellence, is home to research and teaching in the humanities as well as natural, life and social sciences. Taking advantage of established and cutting-edge research, it paves the way for students to further their education, discover the changing world and challenges of modern societ

It constantly expands and updates its research programmes and courses of study, with particular emphasis on their interdisciplinarity and internationalization. It increases the variety of forms and modes of study and gives students the opportunity to shape their individual course of study.

The University, acting on a local and global level, ensures excellent diploma quality and universal access to knowledge.

The University cares for the development of its greatest asset - the intellectual capital of its research, technical and administrative staff, as well as students and doctoral students.

The University builds a community of professionals, a community of people who have discovered the value of mutual cooperation.



Polish Chemical Society

Polish Chemical Society, active for over 100 years, besides gathering researchers working in chemistry is also an institution of public benefit, whose main aim is to support development of chemistry and popularization of this area of science.

The society was founded of 118 Charter Members on 29 June 1919 on the initiative of Leon Marchlewski, Stanisław Bądzyński and Ignacy Mościcki, future President of Poland who was a chemist himself. The initial aim of the organization was to bring together Polish chemists previously working under different partitions as well as from abroad. It was founded in three Polish cities: Lwów (today Lviv in Ukraine), Kraków, and Warsaw and the first scientific meeting was organized in Warsaw on 1 November 1919 by the executive board of the society. After the Second World War, the society was reactivated in 1946 and continues its activities until today. It has 1,959 members, who work in 20 regional centres. In 2006, the Polish Chemical Society became a public benefit organization.

The statute states that one of the goals of the society is "the encouragement of progress of chemical science and propagation thereof among the public, as well as representation of the professional interests of chemists, both researchers and those industrially employed".

Currently, the offices of the society are located in the 18th-century tenement building at Freta Street 16 in the historic city center of Warsaw. The building is the birthplace of Marie Curie and also houses the Maria Skłodowska-Curie Museum (MMSC).

The main activities of PCS include:

- Organization of seminars, conferences and scientific meetings,
- Organization of public presentations, lectures and courses,
- Publication of scientific journals and other specialistic papers
- Participation in international consortia publishing scientific papers,
- Substantive support of the Olympic Games in Chemistry,
- Establishing libraries and library collections,
- Cooperation with scientific organizations for students,
- Cooperation with research institutions and chemical industrial companies.

Scientific committee

prof. Haeshin Lee
Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea

prof. Vincet Ball
Centre de Recherche en Biomédecine de Strasbourg, Institut National de la Santé et de la Recherche Médicale, Strasbourg, France

prof. Daniel Ruiz-Molina
Catalan Institute of Nanoscience and Nanotechnology (ICN2), Bellaterra, Barcelona, Spain

prof. Radosław Mrówczyński
Faculty of Chemistry, Adam Mickiewicz University, Poznań, Poland

Honorary members

prof. Izabela Nowak
Faculty of Chemistry, Adam Mickiewicz University, Poznań, Poland
Polish Chemical Society

Organizing committee

prof. Maciej Kubicki
Conference organizer

prof. Radosław Mrówczyński
Conference Chairman

Konrad Kuczyński, PhD
Conference secretary

Jakub Grajewski. PhD
Conference organizer

Agnieszka Grajewska PhD
Conference organizer

Miłosz Papierski
Conference organizer

Bartosz Świątczak
Conference organizer

Jakub Wawrzyniak
Conference organizer

Recommended attractions in Poznań

If you find time to explore Poznań on your own, we offer you these four unique attractions that you will not find anywhere else in Poland or Europe. All of them have been personally tested by us and are available in English.

The Enigma Cipher Centre

The Enigma Cipher Centre tells the unknown story of the success of Polish mathematicians. It popularises the story and places it in the history of ciphers and international technological change. The Centre runs educational, cultural, and scientific workshops which inspire social activity in the city centre.

The Enigma Cipher Centre not only pays tribute to the outstanding Polish cryptologists, but it also presents the history of encoding messages over the centuries and of the development of computers and computer science, which are the result of the work on deciphering enemy messages during the Second World War. This fascinating tale is told with the use of multimedia and scenography as well as keepsakes from the lives of the cryptologists.

Exhibition devoted to the Poznań cryptologists is located in the exact spot where during the interwar period stood the building of the Poznań branch of the Cipher Bureau, which employed Rejewski, Zygalski and Różycki. By presenting the story of the victory of the human mind over a machine which the Nazi used to conquer the world, we educate and promote the Centre's values such as open-mindedness, teamwork, joint effort, courage, and persistence in pursuing even the most difficult goals.

Enigma Cipher Centre
0Św. Marcin street 78
61-809 Poznań

https://csenigma.pl/en/

Porta Posnania

Porta Posnania tells the story of the beginnings of the Polish state and the Cathedral Island. There are no museum exhibits here. We present our history in a modern way, with multimedia and light.

Visiting the Porta Posnania has two stages: first is a unique exhibition located in a minimalist building, the second one is a walk through the cathedral island. The audio guide is available in as many
as 8 language versions: Polish, English, German, Spanish, French, Czech, Russian and Ukrainian. Various sightseeing options are available: for young people and adults, as well as for families with children.

Porta Posnania ICHOT
2 Gdańska street
61-123 Poznań

https://bramapoznania.pl/en/

Poznan Croissant Museum and Experience

St Martin Croissants are unique local pastries with white poppy seed filling which have enjoyed the status of Poznan's ultimate sweet treat for the last 150 years. As a product with Protected Geographical Indication recognised by European Union, St Martin Croissants may only be produced in the Wielkopolska region and only according to a specific recipe. A treat not to be missed when you're visiting Poznan!

During your visit to Poznan Croissant Museum, you will have an opportunity to listen to the legends about origins of St Martin's Croissants, find out about the ingredients and recipe, and – last but not least – taste the pastry yourself. You will participate in preparations of St Martin Croissants and help our Croissant Master in using traditional confectionery utensils. As you climb the stairs, you will get a chance to look at photographs and press ads presenting fascinating history of this special local delicacy.

Stary Rynek 41/2 (entrance from Klasztorna Street 23)
61-772 Poznań

https://rogalowemuzeum.pl/en/

ZAMEK Culture Centre (Imperial Castle)

The monumental edifice that used to be a residence of the German emperor was built in the years 1904-1910 according to a design by Franz Schwechten, who apparently took on board many suggestions from Kaiser Wilhelm II himself. The castle was a pivotal element of "the castle district" projected as a visiting card of the city and testifying to its supposedly German origins.

The architecture of this neo - Romanesque, multipartite structure harks back to medieval castles, and its individual parts are modelled on Romanesque monuments in Germany and Italy. The whole structure is dominated by the tower with a clock, originally 74 metres high. It was designed by August Oetken and modelled on the famous Capella Palatina in Palermo. In the east part of the edifice there was a magnificent throne chamber. Emperor Wilhelm II stayed here twice: first at the inauguration in 1910 and then in 1913.

In the years between the wars the castle was a residence of the Polish President and a part of it was used by the Poznań University. During the German occupation the edifice was rebuilt as a Hitler's official residence; it was then that the showy entrance from Święty Marcin Street was added. Also the tower chapel was closed and a small balcony built on the south wall.

The castle was so badly damaged in 1945 that some cogitated that it should be demolished. In the end it was rebuilt, but without restoring some elements of its external decorations. In addition, the tower destroyed during the wartime fighting was made some 20 metres lower.

Today the castle is run by a cultural entity, Centrum Kultury "Zamek". It also houses other institutions, such as the Animation Theatre and a cinema. In the Rose courtyard there is a fountain modelled on a 13th century lion fountain in the Alhambra Palace, Grenada.

ZAMEK Culture Centre in Poznań
ul. Św. Marcin 80/82
61-809 Poznań

https://ckzamek.pl/podstrony/6071-zwiedzanie-zamku/

Recommended gastronomy in Poznań

Poznań's gourmet scene is developing at an amazing pace. We have selected a few different restaurants for you, where you can try not only the delicacies of the cuisine of Poznań and the surrounding area, but also be inspired by the dishes prepared by the best Poznań chefs.

Modra Kuchnia

One of the best restaurants serving local cuisine characteristic of the Poznań region. All dishes are prepared in accordance with traditional cuisine and have original local ingredients, but dishes served with "PYZA" - home-made steamed dumplings/buns are especially worth recommending. There are also vegetarian and vegan options on the menu.

Mickiewicza street 18/2,
Poznań 60-834

Zen On

What can be created from the combination of Japanese cuisine and Poznań stubbornness? In this case, a restaurant recommended by the Michelin guide was created, located in the city center near the promenade at St. Martin Street. Dishes with hand-made udon noodles are especially worth recommending. The chef transferred the atmosphere of small Japanese restaurants straight to the streets of Poznań, where the boom for Asian cuisine has been going on for several years.

Ratajczaka 25,
61-814 Poznań

Rynek 95

Located in Poznan's old market square, this restaurant is an ideal meeting place for people who appreciate modern European cuisine. Delicious dishes are served in a rustic restaurant with a vaulted brick cellar. From the restaurant you can usually watch the life going on in the tourist center of the city, it is a great place to start or end a city tour.

Stary Rynek 95
61-773 Poznań

Szarlotta Restaurant

Located in the Poznań city centre, Szarlotta Restaurant is situated on Świętosławska, a charming street off Stary Rynek, the old market square, and leading to the Poznań parish church. Surrounded by historic monuments and other points of interest, our restaurant radiates an intimate atmosphere, making it a special place to stop for a while. With European and Polish dishes in Szarlotta you will experience a different take on traditional cuisine, with our diverse menu featuring local specialties. Discover your own very special place in Poznań.

Świętosławska 12,
61-840 Poznań

SPEAKERS

Daniel Ruiz-Molina

CSIC Professor and Group Leader of the nanostructured Functional Materials at ICN2

Daniel Ruiz-Moina earned his PhD in polyradical dendrimers at the Institut de Ciència de Materials de Barcelona (ICMAB-CSIC) under Prof. Jaume Veciana. He then took a postdoctoral position at the University of California San Diego (USA), where he spent three years working on single molecule magnets and molecular switches. Since 2001 he has held a permanent position as a Spanish National Research Council (CSIC) researcher, most recently at the ICN2, where he is the leader of the ICN2 Nanostructured Functional Materials Group also known as NanosFun. His main research areas include the fabrication of hybrid colloids and surfaces, biomimetic functional nanostructures, and micro- or nanoparticles for smart applications and encapsulation and delivery systems.

Tomasz Ciach

Warsaw University of Technology, Head of Biotechnology and Bioprocess Division,

I am a scientist and engineer focused on applied research on the border of chemistry, nanotechnology and medicine. I work on drug delivery systems: various types of drug delivery devices, nanoparticles, implants or injectable systems designed to deliver the drug in the proper place and rate. Nanotechnology – nanoparticles for targeted drug delivery, cancer treatment and caner diagnostics, advanced coatings for medical implants. Medical devices per se and implants: bone, cartilage, vascular prosthesis, cell encapsulation. Advanced coatings for medical devices and implants regulating proteins and cell attachment and decreasing platelet activation.

Technologies already introduced on the EU medical market:
- drug eluting coatings for coronary stents, Balton, Warsaw.
- biocompatible low friction coatings for urological catheters, Galmed, Bydgoszcz.
- hydroxyapatite nanoparticles for bone implants, human trials stage.
- drug eluting coating for urological catheters, animal trials stage.

Founder or cofounder of multiple university spinoff companies: NanoVelos, NanoSanguis, NanoThea, NanoGroup, GreenGoods, Science4Beauty and Stenocoat.

Anna Belcarz

Assistant professor at Medical University of Lublin - is an employee of the Department of Biochemistry and Biotechnology of the Faculty of Pharmacy of the Medical University of Lublin. She obtained her PhD degree in biological sciences at the Faculty of Biology and Earth Sciences of the Maria Curie-Skłodowska University in Lublin, and her habilitation degree at the Medical University of Lublin.
Currently, the leading area of her research is the chemical and biological modification of biomaterials used, among others, in vascular, dental, orthopedic and urological surgery for their antibacterial protection. She also develops new solutions in the production of composite materials. He has over a dozen Polish and foreign patents, several dozen scientific publications and participation in research projects, e.g. Polish NCN and M-EraNet as part of the Horizon 2020 program.
Her area of interest also includes the commercialization and implementation of medical devices. This was reflected in the participation in the establishment of the spin-off company Medical Inventi S.A., which aims to commercialize the FlexiOss® composite. In 2020, this composite received the CE certificate issued by the Polish Center for Research and Certification S.A. for three products brands (in orthopedics, dentistry and veterinary medicine) and is currently distributed in Poland, Hungary, Italy, UAE, Croatia and Slovakia. As part of the work of the company, Professor Anna Belcarz, manages R&D and FlexiOss® production. She also collaborated scientifically with companies from Poland and the USA (UNILAB LP, USA).
Her scientific and business activities have been honored with many awards, including the Silver Cross of Merit of the President of the Republic of Poland (2019), the Maria Curie Scientific Award (2014), the Award of the Minister of Science and Higher Education (2014), three awards (gold medal with distinction, WIPO award and Grand Prix) at the Brussels Innova Fair (2013) and the Prestige Award of Renown of the Year 2013 for the bone replacement composite (2014).

Radosław Mrówczyński

Faculty of Chemistry, Adam Mickiewicz University, Center for Advanced Technologies, Uniwersytetu Poznańskiego

Radosław Mrówczyński obtained his Ph.D. in organic and bioorganic chemistry at Humboldt University in Berlin under Prof. Jürgen Liebscher supervision. His doctoral thesis was dedicated to the application of nanomaterials in organocatalysis and their functionalization with biomimetic polymers. Next, he moved to the NanoBioMedicla Centre at Adam Mickiewicz University in Poznań where he worked on a drug delivery system based on nanomaterials. He got a habilitation (postdoctoral degree) at the Academy of Mining and Metallurgy in Cracow in biomedical engineering. In 2021 he moved to the Faculty of Chemistry of Adam Mickiewicz University where he continues his work on the application of biomimetic nanoparticles in nanomedicine, synthesis and application of catechol-based coatings and polymers and their structural investigation. Prof. R. Mrówczyński is the head of the Laboratory of Nanomedicine and Biomedical Engineering at the Center for Advanced Technologies UAM and a member of the Stereochemistry Group at the Faculty of Chemistry. His scientific achievements were recognized by the scientific community thus, he was awarded with START scholarship from the Foundation for Polish Sciences and a scholarship for Outstanding Young Scientist by the Polish Ministry of Education. He was a Principal Investigator of research grants from the National Science Centre, Poland and the National Science Centre for Research and Development, Poland dedicated to nanomedicine. At present, he leads the OPUS project from the National Science Centre, in which he works on a smart drug delivery system for liver cancer.

Vincent Ball

Vincent Ball studied Physics and Physical Chemistry at the Université Louis Pasteur, in Strasbourg, France, from 1988 to 1993. In september 1993, he started his PhD in Surface Science under the supervision of Prof. Pierre Schaaf. He investigated the mechanism of protein exchange and lateral mobility at solid-Liquid interfaces. After his PhD defense (june 1996) he was a Lavoisier fellow at the Biozentrum of the Basel University. He worked under the supervision of Dr. Jeremy Ramsden to investigate the kinetics of protein adsorption as a function of different physico-chemical parameters at solid-liquid interfaces using optical techniques.
He then got an assistant professor position in 1997 at the Université de Strasbourg to teach Physical and Analytical Chemistry. Between 1997 and 1999, his research interests were focused on the use of electrospray mass spectrometry to investigate the interaction thermodynamics of ligands with biological receptors, mostly multimeric enzymes. In 2000 he joined the Charles Sadron Institute to investigate fundamental aspects of films assembled through the Layer-by-Layer deposition method.
After the obtention of his habilitation (November 2001) and a full professor position at the Université de Strasbourg (September 2005) he investigated fundamental aspects of many surface processes implying biological molecules and cells. He started to work on the deposition of polydopamine films and on other versatile deposition methods from 2008 on after a sabbatical stay at the Michigan University (Fullbright fellowship). After 2020, he shifted his interests to electrochemical deposition process from solutions containing polyphenols to yield conformal and bioactive films with applications extending to other fields of materials science. He supervised 11 PhD students and 1 post doc between 2003 and 2023 and contributed to 215 peer reviewed articles.
Vincent BALL is teaching Physical Chemistry, Solution Chemistry and Materials Science to students at the Medical and Dental Faculty in Strasbourg. This allowed him to publish a monography ("*Self-Assembly Processes at Interfaces. Multiscale Phenomena.*" published in december 2017, Elsevier, ISBN 978-012-801970-2) in December 2017.

Maria Laura Alfieri

Maria Laura Alfieri received the Degree and the Ph.D. degree in Chemical Sciences in 2016 and 2020, respectively at the University of Naples Federico II. From 2016 to 2021 she received several research grants from the Department of Chemical Sciences of University of Naples Federico II and since June 2021 she is a fixed-term Researcher of Organic Chemistry at the same Department. She has authored more than 30 publications in international journals. Her current research interests include chemistry, structure and properties of polydopamine and melanins; the design and characterization of bio-inspired functional materials as interfaces for biomedical and technological applications; mechanisms of underwater adhesion; chemistry of catechols and quinones of natural origin in relation to the development of functional systems; design and characterization of bioinspired/chemically modified phenolic polymers with antioxidant, anticoagulant or antifouling properties.

Cordelia Zimmerer

Graduated in chemistry from the University of Technology Dresden (TUD), Cordelia Zimmerer started her career at the Institute of Plant and Wood Chemistry in Tharandt, Germany. Her subsequent PhD at the TUD was dedicated to the development of a bionic ion channel sensor array at the Institute of Analytical Chemistry. Afterwards she moved to the Leibniz Institute of Polymer Research (IPF) Dresden e.V. and has been leading the research group "Interfacial Design and Characterization of Polymer Materials" at Department of Polymer Materials. The main focus of the interdisciplinary research group is to study and to develop new kinds of bioinspired materials including their molecular and biological bases, processing, materials engineering, physics, and theoretical chemistry. The group collaborates with different nonacademic institutes, industrial partners and academic partners from Germany and abroad. Cordelia Zimmerer has acquired a broad range of publicly funded third-party projects and is in charge of numerous industrial projects. She has published more than 140 original peer reviewed research and review articles. Currently she also chairs the Scientific and Technical Council of the IPF Dresden e.V. The development of new polymer interface designs for material research in multimaterial systems has to her mind the potential to substitute environmentally pernicious process steps in established industrial process chains to revise and re-develop technological processes. Together with her colleagues and partners, she develops bioinspired approaches for technical levels, upscaling and in-process implementations of laboratory solutions. Cordelia Zimmerer is immersed in educating and supporting students in cooperation with several Universities, such as University of Technology Dresden, University of Technology Chemnitz, University of Applied Sciences Dresden etc. She has teaching experiences e.g. for Boston University, U.S. and Vilnius University, Lithuania

Jurgen Liebscher

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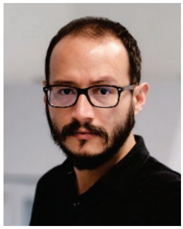
Scientific Profile

- Organic synthesis
- Heterocyclic Chemistry
- Polydopamine and analogues
- Functionalized magnetic core-shell nanoparticles
- -Ionic liquids
- Organocatalysis
- Chemistry of organic hydroperoxides and peroxides

Emerson Coy



Dr hab. Emerson Coy, is an associate professor at the NanoBioMedical Centre of Adam Mickiewicz University, Poznan, Poland, where the research group of "*Hybrid Nanomaterials and Interfaces*", is leading an international/interdisciplinary group of scientists and students. Prof Coy is the PhD supervisor of six PhD and two Master students, having successfully graduated two PhD students. He received his Habilitation degree in material sciences from the AGH University of Science and Technology, Krakow - Poland 2019. He received his PhD in Nanoscience from the University of Barcelona, Barcelona - Spain 2016. He holds a Master's degree in applied and computational physics from the Polytechnic University of Catalonia, Spain, in 2009 and a Master's degree in Nanotechnology from the University of Barcelona in 2008. Additionally, Dr Coy holds an engineering degree from Manuela Beltran University, Bogota - Colombia, obtained in 2006. Dr Coy has been awarded five National Science Center research grants (Preludium, Preludium Bis, Sonata and Opus grants).

Additionally, he has participated in several international (Horizon2020) and European-level grants, including an international grant from the European Space Agency (ESA). Dr Coy has been invited as a plenary speaker at more than 17 international and national conferences. Furthermore, he has been awarded several institutional, national and international awards, most noticeable, the Ministry of Education stipend for young scientists, the University of Tomorrow (IDB) grants for most active researchers, the FPI grant from the Spanish Government for PhD studies and the Colfuturo-grant for Postgraduate studies.

Finally, Dr Coy has authored and co-authored more than 170 international peer-reviewed articles on different topics. His research interests are mainly focused on hybrid films/coatings, functional heterojunctions, carbides, multiferroics, nanoindentation, composite materials, photocatalysis and energy harvesting.

Christopher Synatschke

Christopher Synatschke studied chemistry at the University of Bayreuth, Germany, including a DAAD-supported research stay at the Center for Advanced Macromolecular Design (CAMD) at The University of New South Wales, Australia. He then pursued his PhD under the supervision of Prof. Axel H.E. Müller, studying multicompartment micelles and star-shaped polyelectrolytes. During this time, Christopher had the opportunity to visit the group of Prof. Kazunori Kataoka at The University of Tokyo for a 6-month research project on anti-cancer therapy. After completing his PhD with distinction (summa cum laude) in 2013, he then joined the group of Prof. Samuel Stupp at Northwestern University in Chicago as a Feodor-Lynen Postdoctoral Fellow (Humboldt Foundation) working on supramolecular-covalent hybrids. Upon returning to Germany in 2017, Christopher joined the Department for Synthesis of Macromolecules headed by Prof. Tanja Weil at the Max Planck Institute for Polymer Research first as a postdoctoral fellow and was promoted to group leader in 2018 where he now combines his background in polymer and supramolecular chemistry to develop self-assembled biomaterials.

Bartlomiej Graczykowski

obtained his Ph.D. in Physics in 2012 (AMU, Poznan, Poland). He was appointed as a postdoctoral researcher at ICN2 Barcelona in Spain (2013–2016) and MPIP Mainz in Germany (A. von Humboldt Foundation fellowship, 2016–2017). Currently, he is an assistant professor at the Faculty of Physics of Adam Mickiewicz University in Poznan, Poland, and a guest researcher at the Max Planck Institute for Polymer Research in Mainz, Germany. His research activities include advanced inelastic light scattering techniques (Brillouin, Raman) applied to nanostructures, hypersound, and heat transport at the nanoscale in confined and organized systems.

Yeonho Kim

(1984) is an assistant professor in Department of Applied Chemistry at Konkuk University, Republic of Korea. He received his Ph.D. degree from Seoul National University in 2015. His research group is interested in photochemistry, including the synthesis of nanostructured materials such as metal oxide, silicon, and their composites with their surface modification and application to energy and environmental fields.

LECTURES

Catechol-based nanostructures in medicine

Daniel Ruiz-Molina

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Catechol-based systems have in recent years been subject to intense research, aimed at mimicking natural systems to develop new functional materials and coatings. In our group we have been working on different experimental approaches, ranging from the polymerization of catechols
in the presence of amines (ammonia or bisamines) to the oxidative condensation of readily available pyrocatechol and thiol-capped functional moieties. Following both approaches, we have developed supramolecular/polymeric nanoparticles and coatings with a broad range of architectures, functionalities and characteristics. The main application of all these nanostructures is for health and social welfare, mostly though not exclusively:

- Nanoparticles for diagnosis and therapy.
- Fine-tuning of hydrophilicty, biocompatibility or bactericides via surface (bio)functionalization.
- Thin films for the regeneration of human cells/tissues.

In this talk I will give a brief overview of our three research lines using representative examples.

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Oxidative polymerization of various phenylamines for medical coatings

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Since dopamine oxidative polymerization leading to the formation of complex in structure dark polymer precipitating from the water solution as nanoparticles and covering every immersed surface with ultrafine coating has been discovered, a lot of possible applications of this process and new raw materials were proposed. Experimental work proved, that not only dopamine can be polymerized during oxidation, but also adrenaline, phenylalanine, tyrosine, phenylethylamine and other [1]. In some cases, simple air oxidation is enough, but in some stronger oxidizers like periodate or Fenton reaction should be employed. The last approach is necessary especially in the case of the lack of hydroxyl group in the phenol ring. Even copolymerization of phenols and amines in oxidative conditions can also lead to the similar polymers. Depending on the raw materials employed and polymerization conditions applied, process runs with different kinetics and obtained materials may have slightly different properties, but always dark suspension and fine dark coatings are produced. Poly phenylamines (PPA) coatings are very attractive for medical engineering since they are easy to produce on virtually any surface – even of very complex shape and very low surface energies. They are completely nontoxic and offer perfect mammalian cell adhesion. During the formation process and shortly after, they can be covalently modified with additional mono-molecular layer of amine bearing molecules, like amino acids and peptides. We have shoved PPA coating application in vascular prosthesis. Solution blow spinning made vascular prosthesis were coated with various PPA and then actively seeded from inside with human endothelial cells using magnetic nanoparticles and directed magnetic field. PPA layer improved cell adhesion and proliferation [2], coating also exhibit low platelet activation properties. PPA coatings likewise improve bone cell adhesion and proliferation in granular bone implants [3]. PPA coating can also be employed to form cell adherent patterns for local directed smooth muscle cell adhesion and proliferation, what can be useful in the case of some tissue regeneration processes [4]. Also, nanoporous membranes for controlled drug delivery coated with PPA and further covalently modified, can prevent protein adhesion what decrease drug transport. We think that versatile PPA coatings can find multiple application in the production of medical devices and implants.

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Natural polymers – matrices for polycatecholamine coating

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Due to the global trend to replace non-degradable materials with natural and biodegradable ones, there is also a tendency to use natural polymers in the field of biomaterials and medical devices. Examples of such polymers are cellulose, chitosan, alginate, collagen, gelatin, fibrin and many others. However, it should be remembered that in addition to many advantages, they also have disadvantages. These include the lack of a consistency and repeatability of chemical composition, irregularity and heterogeneity of the structure, often poor values of key parameters important for particular therapeutic process (e.g. promoting colonization by bacteria or lack of ability to stimulate biomineralization).

Some of these problems can be solved by various modifications. Since the disclosure in 2007 of the procedure for deposition of polydopamine on various matrices [1], burst of interest in this method for the modification of various types of materials has been observed. One of of polydopamine applications is the modification of biomaterials, including implantation materials. The great advantages of polydopamine in this context include, among others: easy adhesion to metals, ceramics and polymers with complex 3D structure, antibacterial properties of polydopamine, supporting the adhesion and proliferation by human cells, stimulation of biomineralization, antioxidant properties, the ability to bind active substances containing free amino and thiol groups and mild process conditions, usually not damaging the modified matrix. The properties of polydopamine therefore make it, like other catecholamine derivatives, a preferred choice when looking for ways to modify delicate natural polymers.

In attempts to modify natural polymers with polydopamine for medical applications, a variety of phenomena should be taken into account, including the stability of both coatings and matrices after modification, non-toxicity, interactions with various human and bacterial cells, mechanical properties and many others factors. The procedure of coating polymers with polycatecholamines and the choice of factors supporting dopamine polymerization (e.g. persulfate, hydrogen peroxide, laccase) may be of key importance for the final biological properties of the biomaterial obtained. Therefore, the appropriate design of the biopolymer modification procedure with polycatecholamines should be the first step in planning research.

Acknowledgments

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Chemistry of nanoscale polydopamine-based materials

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Polydopamine is a versatile material that found a broad application in different research areas including catalysis, energy storage and water remediation. Moreover, polydopamine has gained a lot of interest in the synthesis of functional nanostructure for medical applications, particularly in the preparation of smart drug delivery systems. The proven biocompatibility, strong photothermal properties and straightforward functionalization are features decided about the success of polydopamine in the aforementioned area. In this talk, the application of polydopamine in the synthesis of nanocarriers for smart drug delivery systems will be presented. We will also show the possibility of delivering two chemotherapeutic drugs for liver cancer. Further, we will also present new polycatecholic coatings and their application as stimuli-responsive gatekeepers to protect and release on-demand payload from porous materials. We will also discuss the photothermal properties of obtained materials in different biological windows, what makes them a potential candidate for application in combined chemo-photothermal therapy of hepatocellular carcinoma. Finally, we will present the new catechol chemistry towards analogues of polydopamine.

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Oxidized dopamine, polyphenols and aminomalononitrile: from functional hydrogels to graphene oxide like materials.

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Several aspects of the use of catechols and catechol amines to functionalize surfaces or to modify the bulk properties of materials will be presented. The addition of small polyphenols or dopamine to gelatin hydrogels in oxidaive conditions is shown to produce strongly adhesive hydrogels without covalent binding to the polymer undergoing gelation [1]. The same molecules can be oxidized at electrodes without undergoing oxidation in the bulk of the solution to produce thin coatings which can display graphitic structure depending on the used polyphenol [2,3]. Finally, the possibility to coat a broad class of materials with thin films will be extended to molecules like aminomalononitrile [4]. The overall scope of this presentation will be to show that the polydopamine films and nanomaterials research topic is far from being at its achievement provided some fundamental questions continue to be asked.

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Novel mussel-inspired functional materials *via* site-specific polymerization and deposition of dopamine

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The mimicry of the underwater mussel adhesion strategy for the development of innovative and versatile dip-coating technologies is exemplified by the introduction of polydopamine (PDA) as a highly adhesive biomaterial for surface functionalization, incorporating the key catechol and amine functionalities of byssal proteins. [1] Despite unabated interest and an ever-expanding use for various applications,[2] most of the methods studied to improve or manipulate PDA properties are multistep and time-consuming. Furthermore, the polymerization process requires alkaline conditions or the use of oxidants, causing uncontrolled precipitation of polymer in the reaction medium. Thus, development of selective methodologies for the site-controlled functionalization of surfaces appears to be an important goal for various technological and biomedical applications.

In this framework, halloysite nanotubes (HNTs), an aluminosilicate clay belonging to the kaolin group, represent a versatile core structure for the design of functional nanosystems of potential technological and biomedical interest thanks to their mechanical strength and good biocompatibility. Up to now, relevant publications on HNTs reported the PDA coating on the overall HNTs external surface under basic conditions without polymerization control. Herein, we report the first procedure for a site-selective functionalization of HNTs with PDA, under neutral conditions, exploiting the basicity of ZnO nanoparticles anchored on the HNTs external surface. Notably, hyperthermia studies revealed that the nanomaterials induced a local thermic rise under NIR irradiation with good photothermal stability for many cycles of laser on/off operations. [3] Furthermore, the nanomaterial displayed good properties as an anchoring point for the grafting of biotin and subsequent avidin interaction, to obtain a potential drug delivery system with therapeutic synergies.

Herein, we also report recent studies in which the tyrosinase-catalyzed polymerization of tyramine is proposed as a mild, versatile and efficient procedure for the development of adhesive PDA-type films at neutral pH (*i.e.* 6.8) and at much lower substrate concentration (*e.g.* 1 mM) compared to the standard air oxidation PDA coating protocol. Finally, the possibility of using tyramine together with confined tyrosinase to achieve site-specific polymerization and/or film deposition is assessed against dopamine.[4] The rationale of the experiments is to prevent the uncontrolled autoxidative deposition of black precipitate, a major drawback of PDA coating technology which may interfere with technological applications.

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Polydopamine-mediated materials adhesion of plastics and metal – key to ecofriendly material design and processing

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High-tech materials, components, and devices for different applications base on designed interface and surface properties or multi-material combinations. Their production often requires energy-consuming processes or the use of hazardous substances. Perspectives for bio-inspired interface design and biodegradable materials are offered by a class of compounds derived from adhesive mussel proteins: dopamine (DA), its polymerized form polydopamine (PDA), and analogue compounds.

Following the adhesion concept of the blue mussel, Mytilus edulis, DA-based films seem to be suitable for various types of substrates for surface modification and compatibilization to produce composites and hybrid materials. A key role in substrate materials in the technical world is played by plastics as substitutes for metals in technology and design.

Due to the versatile adhesion abilities of DA, its oxidation products, oligomers or polymerization products and associates, it is possible to promote adhesion between plastics and metals and re-develop new production chains and processing [1,2]. The bioinspired design of interfaces represents a very interesting process alternative to the state-of-the-art in plastic metallization and plastic electroplating, esp. the unsolved recycling and remanufacturing issues.

Conventionally, highly toxic chromium (VI) compounds or organic solvents are used to convert the plastic surfaces into a suitable adhesive base for the metal layers.

To demonstrate that plastics can be metallized for industrial process chains by means of DA and its analogues, and that the composites produced in this way also meet technical requirements in both the functional and decorative areas, the current investigations are moving in the direction of technological process design. They form the key to subsequent industrial application [3].

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Modifying the Structure of Dopamine – Consequences to Polymer Formation

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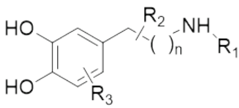
Polydopamine has gained enormous importance in research and practical application in various fields, e.g. as universal coating material for almost all types of surfaces, in separation techniques, wound healing, regenerative medicine, catalysis, electronics, corrosoin protection ... Despite of intensive research there still exist a number of shortcomings, such as precipitation as competition to surface coating, long reaction times, sometimes non-tolerable reaction environments. To overcome such problems, reaction conditions (oxidizing reagents, solvents, pH, temperature) and deposition techniques have been altered. Modifying the structure of dopamine opens another way to address those shortcomings by obtaining analogues of polydopamine with different, desireably better properties. The lecture will provide some inside into the possiblities of this strategy and to demonstrate scope and limitiations. In addition, such investigations can provide conclusions to the structure and formation of polydopamine. Examples of all structural parameters (additional substituents at the amino group, at the alkyl side chain, in the benzene ring, length of alkyl side chain, heteroatoms in side chain) of dopamine are discussed.



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Possible Supramolecular Ordering in Polydopamine Films.

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Polydopamine is an inherently amorphous biomimetic polymer whose structure remains vigorously studied. Here we discuss the possible supramolecular ordering observed in Polydopamine(PDA) films grown at the air/water interface[1,2]. We will show the experimental methods and results that support our observations and discuss possible interpretations and further experimental aspects. Our results show exciting possibilities for exploring and controlling the structure of PDA. This might prove invaluable for the community working on this biopolymer and allow the further tailoring of its functional properties in multiple applications.

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Ultrathin Films and Self-Standing Membranes from Polydopamine: A New Material For Photocatalysis, Biosensors, And Water Filtration

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High demands for the more environmentally, friendly, and green processes have inspired new research in bio-derived polymeric materials. However, the extraction and processing of large, complex biopolymers such as cellulose, chitin, and carbohydrates for industrial use often produce extensive amounts of waste. In contrast, using small bio-derived molecules as raw materials for the bottom-up synthesis of polymers produces less waste owing to their material properties.[1] Polydopamine (PDA, formed by the oxidation of neurotransmitter dopamine), owing to its biocompatibility, excellent resistance to nearly all organic solvents, high adhesion to various materials and surfaces, and rich chemistry, has become a suitable candidate for various applications, particularly as coatings for medical devices, membranes, and biosensors. While, PDA is widely used as a functional coating,[2, 3] examples of free-standing PDA films of controlled thickness or geometry are scarce. Herein, we report the ultrathin, homogenous, and freestanding PDA films produced by electropolymerization, which solves the long-standing challenge of fabricating polymeric films with precisely controllable and ultrathin geometries. Furthermore, we found that PDA films possess great application potentials in photocatalysis, biosensors, and water filtration.

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Mechanical and thermal engineering of functional nanomembranes

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Continuous miniaturization of electronics, increasing computing power and data transmission speed, an alternative to silicon-based electronics, and obtaining new sources of clean energy are among the most vital challenges in physics, chemistry, and material engineering. The search for new materials, structures, and composites that can meet these requirements has contributed to the spectacular development of nanoscience and nanotechnology in the last two decades. What is essential, the search for new nanomaterials with application potential is often a compromise between excellent properties and incurred energy and environmental costs.

In this talk, I will present the results of experimental research focused on quasi-2D structures such as few-nanometer thick freestanding membranes based on organic and inorganic materials. The mains focus will be on (i) the energy harvesting in nature-inspired membranes for ultra-fast light-to-motion conversion[1], (ii) consolable flow of heat in silicon thermal diode[2], (iii) elastic size effect in MoSe2[3], (iv) GHz signal filtering in 2D hybrid colloidal crystals[4]. The core part of the talk will be dedicated to mechanical and thermal evaluation of ultra-thin materials utilizing all-optical methods.

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Design of Polydopamine-Semiconductor Nanocomposites for Energy Application

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Nanocomposite photocatalysts have attracted extensive attention in the solar light-assisted photocatalytic chemical fuel production field that resolves future energy crises and environmental issues. Because the nanocomposites photocatalyst showed excellent photocatalytic activities than that of pristine semiconductors for H_2 production. Better activity is initiated from the formation of heterojunction structure, which might suppress the recombination of photogenerated charge carriers that effectively improve photocatalytic efficiency. In this talk, recent research efforts on the rational design of polydopamine-semiconductor nanocomposite photocatalysts toward energy application are presented.

POSTERS

Polydopamine Coated Gold Nanorods: Study of Photothermal and Photocatalytic Properties

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Localized surface plasmon resonance (LSPRs) presented by gold nanorods (AuNRs) when combined with Polydopamine (PDA) shells results in a strong photo-thermal effect that can be used in biomedical applications. Here, these two materials were combined obtaining a reproducible hybrid nanocomposite where gold is surrounded by PDA. First, AuNR was synthesized by carrying out a seed-mediated growth, and then, by the further self -polymerization of dopamine (DA) on the surface of the AuNR, the final structure was achieved. Following this method, several AuNRs/PDA samples were synthesized with different PDA shell thicknesses, going from ~4 nm to ~30 nm, showing LSPR values in the range between 920 nm and 800 nm. The effect of the thickness of the PDA shell at the composite was studied focusing on the plasmon response of the nanocomposite, the temperature increase, and the photocatalytic performance towards Rhodamine 6G (Rh6G) degradation. PDA shell was able to increase the temperature and improve the photocatalytic yield if compared with their components, showing a degradation of 54% of Rh6G initial concentration within 60 minutes of irradiation with a catalyst concentration of 7.4 µg mL-1. Kinetics of the reaction were studied through the Langmuir-Hinshelwood model which, in combination, with time-resolved spectroscopy, and finite-element-method simulations of plasmons unveiled that AuNRs plasmons, coupled with the low thermal conductivity of PDA, provide low thermalization while enhancing the charge carrier transfer. [1]

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Poster stand 1

Fabrication of thin electroactive polydopamine films by electrospray deposition

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Polydopamine (PDA), following its emergence in 2007, has gathered significant attention, leading to a multitude of potential applications due to its distinct structure and versatile properties. The specific properties of PDA can vary depending on the method employed for its synthesis. [1] The two common approaches for synthesizing PDA are auto-oxidation and chemical oxidation. Although auto-oxidation represents the most common and straightforward preparation method for PDA materials, it results in the formation of PDA structures consisting of large randomly aggregated macromolecules. In this study, our focus lies in exploring the feasibility of fabricating PDA films using copper-assisted chemical oxidation, in conjunction with electrospray deposition, thereby introducing a reproducible and scalable film fabrication technique. PDA incorporates the 5,6-dihydroxindole (DHI) molecules within its structure. DHI has the capability to engage in reversible redox reactions, transitioning between hydroquinone, semiquinone, and quinone states. [2] Making use of PDA's electroactivity, our objective is to establish the potential utility of electrospray deposition as a method to fabricate thin films PDA films with desirable electrochemical properties, for application in biodegradable energy storage devices, specifically focusing on supercapacitors.

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Poster stand 2

Cancer cell membrane coated mesoporous polydopamine nanoparticles for efficient anticancer treatment and imaging.

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Cancer is one of the leading causes of death globally. Nanoparticle-based drug delivery systems that offer multifunctionality are highly sought-after for their ability to provide multiple features in a single medium, which can make cancer treatment more effective and tolerable for patients. However, low delivery efficiency of nanoparticles negatively affects the translation of nanotechnology to clinical applications. One of the most promising active-targeting strategies is a nature-inspired biomimetic approach, in which membranes of living cells, such as cancer cells, are isolated and coated around the nanoformulations.

In this study iron functionalized mesoporous polydopamine nanoparticles were efficiently loaded with doxorubicin and the significant potential of these nanoformulations for use in MRI is demonstrated. In addition, biomimetic coating of the nanoparticles using the HepG2 tumor cell-derived membrane results in prolonged circulation and increased targeting abilities. The biosafety assessment reveals negligible toxicity to normal cells, while showing remarkable cytotoxicity to cancer cells. The photothermal effect evaluation showcase enhanced cytotoxicity upon laser irradiation, highlighting the synergistic effects of the nanomaterials and photothermal therapy. Furthermore, the chemotherapeutic effect assessment demonstrates a high efficacy of doxorubicin-loaded nanoparticles in inhibiting cell viability and proliferation. This study advances knowledge about theranostic, membrane-coated drug delivery systems, highlighting their potential to revolutionize cancer treatment.

Acknowledgements

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Poster stand 3

Bio-inspired plastic metallization with the adhesion promoter dopamine

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As part of the SAB-funded M-era.NET project "InsBIOration - Bioinspired interfaces for the development of next generation degradable multiphase materials", we are working on a platform for bioinspired surface and interface designs based on dopamine. The aim is to develop a portfolio of highly scalable technologies for the "green" production of materials for selected applications, such as anti-pathogenic coatings, biodegradable energy sources and polymer-metal hybrids, and to develop recycling and biodegradation strategies. [1]

Together with our project partners, we are carrying out structure-dependent studies to elucidate the reaction mechanisms of PDA and analogous compounds. [2] In addition, we have started to develop a simulation for the interactions between the model molecule 5,6-dihydroxyindoline, a frequent monomeric building block of PDA, and different types of metals.

The use of bio-inspired adhesion promoters in plastic metallisation can replace the current process, which uses toxic chemicals such as chromosulphuric acid, and achieve environmentally friendly and substrate independent plastic metallisation, in addition to remanufacturing and potential recycling through component separation. Polymer-metal hybrids and bio-inspired dopamine (DA)-assisted metallisation are being developed for automotive applications. Various polymer substrates have been coated with polydopamine (PDA) and metallised with nickel by electroless deposition to understand the adhesion of DA and to determine the conditions for successful metallisation. Different application methods such as dip coating, spray coating, layer-by-layer and electrospray will be investigated. PDA will be tested as a bio-inspired adhesion promoter in a technical scale-up in collaboration with an industrial partner. The objectives are: a) to make industrial coating more environmentally friendly and b) to provide substrate independence. [3]

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Poster stand 4

Polydopamine-Coated CdSe@Cds Nanorods Functionalized with Molecular Catalyst for Photocatalytic Reductions

Marcel Boecker[1], Mathias Micheel[2], Sarah Lander[3], Tommaso Marchesi D'Alvise[1], Julia Moser[1], Christopher V. Synatschke[1], Maria Wächtler[3], and Tanja Weil[1]

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The up-conversion of chemical feedstocks into high-value compounds, such as fuels, via light-induced processes represents a promising approach towards a green industry. In this context, colloidal semiconductor nanomaterials are promising photosensitizers, due to their high absorption coefficients in the visible range, but are prone to undergo photo-degradation. Here, we present a nanocomposite system consisting of CdSe@CdS dot-in-rod nanorods (NR) coated with a thin polydopamine (PDA) shell. The PDA shell serves multiple purposes. First, it acts as a scaffold for molecular functionalization, e.g. with molecular catalysts, using a broad variety of functional groups. Second, PDA acts as a charge mediator in the catalytic system. We follow the electron migration using photoelectron spectroscopy and determine that a fast electron transfer from the photosensitizer to the PDA coating occurs. The electron is further transferred to the catalyst and is available for catalysis.

We demonstrate the catalytic efficiency of the nanocomposite system through the the production of multiple chemical fuels: The reduction of nicotinamide adenine dinucleotide (NAD+) to NADH using an Rh based catalyst and hydrogen production when switching to Co based catalysts.

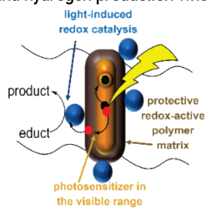

Figure 1: Nanocomposite system, consisting of CdSe@CdS for light-driven reduction.

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Poster stand 5

Ion-assisted levodopa polymerization on vascular prostheses

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Polycatecholamine coatings possess antibacterial properties and can bind antibacterial agents via catechol domains [1]. So, they could be used for vascular grafts modification to reduce the risk of post-implantation bacterial infections. Coating process can be improved by changing physical parameters or by addition of specific oxidants e.g. NaIO4 and H2O2/Cu2+. These strategies may not be suitable to apply to sensitive matrices, such as collagen-sealed polyester vascular grafts [2,3]. For example, free radicals generated from H2O2 by Cu2+ may damage polyester fibres [4,5]. In this study, very mild ion-assisted approach to polylevodopa coatings formation on the grafts was developed and compared to other mentioned methods.

In the first step of the research, concentration of selected ions (Na+, Mg2+, Ca2+, SO42- and Cu2+) was optimized, using standard 10 mM Tris buffer pH 8.5 for levodopa polymerization on FlowNit Bioseal® collagen-sealed polyester knitted grafts (Jotec GmbH, Germany). Efficiency of polymerization was verified by amount of gentamicin immobilized on vascular grafts using the phthaldialdehyde method [6]. Influence of temperature, pH and shaking intensity on the process efficiency also have been verified. In the second step, some properties of the grafts modified by ion-assisted approach and by mentioned above methods described in literature [2,3] were compared.

The parameters of ion-assisted polylevodopa deposition on vascular grafts were optimized. Ion-assisted, NaIO4-mediated and H2O2/Cu2+-mediated methods of levodopa polymerization on vascular grafts occurred faster and allowed to obtain thicker films (based on grafts darkening) than in standard coating procedure (in 10 mM Tris buffer pH 8.5 without mediators) (Fig. 1A). Ion-assisted coatings were more stable compared to NaIO4 and H2O2/Cu2+ (Fig. 1B). Amount of drug bounded by all of the modifications was higher than for standard procedure, that is:

>250% for ion-assisted modification, >800% for NaIO4 and >150% for H2O2/Cu2+.

1A 1B

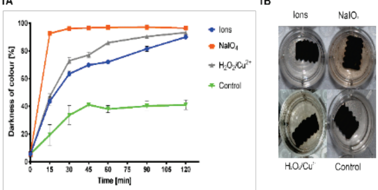

Figure 1. A) Darkening of vascular grafts during coating. B) Stability of coated prostheses.

Conclusions

The mild and efficient method that we developed allows both to bind higher amounts of antibiotic comparing to prostheses coated without addition of metal ions and avoid risks of using stronger oxidants or H2O2.

Acknowledgements

This research was supported by National Science Center (NCN) grant Preludium BIS-3 UMO-2021/43/O/NZ7/00771

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Poster stand 6

Fluorescent bioinspired albumin/polydopamine nanoparticles and their interactions with *Escherichia coli* cells

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The emergence and spreading of antimicrobial-related resistance of bacteria are a current important concern. Furthermore, antimicrobial drugs are often associated with toxicity to host cells as well as damage to commensal microflora. Targeting bacterial pathogens by adequate vectors containing the drug could be a way of improving the specificity of the treatment, while reducing its toxicity for the patient and its microbiota. Known for its biocompatibility, polydopamine (PDA) is already used for biomedical applications, notably as nanoparticles (NPs) which can be used for drug delivery. In this study, stable PDA/BSA NPs are formed by oxidizing dopamine (DA) in presence of bovine serum albumin (BSA). Depending on the BSA/DA ratio, their diameter can vary from 66 ± 16 to 9 ± 3 nm. Their own antibacterial effect was evaluated against *Escherichia coli* (*E coli*) and *Staphylococcus aureus*. The results demonstrate no antibacterial effect at a concentration up to 2 g/L. However, to understand their interaction with *E coli*, they were modified in three different ways to exhibit fluorescence (fNPs) for confocal microscopy. The results show a significantly higher signal in the presence of fNPs compared to *E coli* alone. The high-resolution fluorescence micrographs also demonstrate that the signal comes from the inside of cells with a heterogenous pattern instead of on the outer membrane. Thus, the NPs are entering bacteria cells, and may be used as nanovectors for drug delivery of antimicrobial treatment. Ongoing experiments are performed by transmission electron microscopy (TEM) with immuno-gold labeling in order to confirm these results.

Acknowledgments

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Poster stand 7

Development of Hybrid MXene-Polydopamine Nanocomposites for biomedical applications

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Hybrid MXene and Polydopamine (PDA) nanocomposites have emerged as highly promising targeted and effective photothermal therapy (PTT) platforms. PTT utilizes light-absorbing materials to convert light energy into heat, resulting in localized hyperthermia that selectively damages cancer cells. However, the clinical translation of PTT faces challenges such as limited photothermal conversion efficiency, inadequate tumor targeting, and potential side effects.

MXenes, a type of two-dimensional transition metal carbides/nitrides, exhibit exceptional optical absorption properties in the near-infrared (NIR) region, aligning with biological tissues' maximum transparency. The combination of MXenes with PDA offers synergistic advantages for enhanced PTT. MXenes are efficient photothermal agents, while PDA provides a versatile coating that promotes biocompatibility and enables surface functionalization for targeted therapy.

The hybrid MXene-PDA nanocomposites demonstrate excellent photothermal conversion efficiency due to the intense light absorption of MXenes and efficient heat transfer facilitated by the PDA coating. These nanocomposites can be easily functionalized by targeting ligands or biomolecules, allowing selective accumulation and internalization in cancer cells. Furthermore, the MXene-PDA nanocomposites can be engineered to release therapeutic agents, such as chemotherapy drugs, in response to the photothermal effect, enabling combined photothermal-chemotherapy treatment.

This research presents experimental findings on developing MXene-PDA nanocomposites for targeted and effective PTT. The synthesis methods employed for fabricating the nanocomposites, including surface modification and functionalization, are discussed, along with their photothermal conversion efficiency and biocompatibility. The impact of PDA layer thickness on MXene flakes in PTT is explored, and targeting ligands in the form of antibodies for various types of cancers are utilized. The study demonstrates the promising potential of hybrid MXene-PDA nanocomposites to advance PTT as a cancer treatment modality, leveraging their unique properties, such as high photothermal conversion efficiency and surface functionalization capabilities, for targeted therapy.

Poster stand 8

Coatings with polydopamine analogues as a versatile method of surface modification for implantable medical devices

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Surface properties are crucial in designing and manufacturing implantable medical devices, as they largely determine their biocompatibility and functionality. This work presents the research results on synthesising polydopamine coating and its analogues for functionalising the surface of the materials used in medical devices production. We present novel polycatecholamine coatings obtained by oxidative polymerization of L-tyrosine, L-phenylalanine, and 2-phenylethylamine based on mussel glue-inspired chemistry. We optimized the reaction parameters and examined the properties of coatings compared to the ones obtained from polydopamine. We produced polycatecholamine coatings on various materials used to manufacture implantable medical devices, such as polyurethane, but also hard-to-coat polydimethylsiloxane, polytetrafluoroethylene, and stainless steel. The coating process results in significant hydrophilization of the material's surface, reducing the water contact angle by about 50 to 80% depending on the material type. We showed that the thickness, roughness, and stability of the polycatecholamine coatings depend on the chemical structure of the oxidized phenylamine. In vitro experiments showed prominent hemocompatibility of our coatings and significant improvement of the adhesion and proliferation of human umbilical vein endothelial cells. The full confluence on the surface of coated polytetrafluoroethylene was achieved after 5 days of cell culture for all tested polycatecholamines, and it was maintained after 14 days. Hence, the use of polycatecholamine coatings can be a simple and versatile method of surface modification of medical devices intended for contact with blood or used in tissue engineering. Polytyrosine, polyphenylalanine and polyphenylethylamine coatings are a much cheaper alternative to polydopamine coatings, but they are characterized by lower stability.

Poster stand 9

Polydopamine as foundation of antifouling coatings for polycarbonate nanoporous membranes

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Nanoporous membranes (NPMBs) are an important piece of technology, allowing for selective transport of small molecules through its pores. NPMBs can be designed to cut off large biomolecules, while allowing small proteins to pass. Such qualities allow them to be used in biomedical devices, filtration modules and controlled drug release. When used in limiting of transport of biological molecules in vivo, one should mention the concept of biofouling: physical interaction and accumulation of various substances present in the body fluids (proteins, lipids, plasma) on the membrane. Biofouling might lead to clogging of the NPBM's pores and impair the selective transport capabilities of the membrane. To avoid this, polymeric surfaces can be modified with various physicochemical methods - altering the hydrophilicity by grafting various chemical groups on the surface.

One of proposed strategies is deposition of polydopamine (PDA) layer on the surface of nanoporous polycarbonate membrane, a modification which increases hydrophilicity and protein affinity to the surface. This course of action seems inappropriate, as PDA-coated surfaces offer excellent cell adhesion and protein coverage. [1] However, this synthesis introduces numerous amine groups to the surface, which can be used as crosslinkers. Our protocol of dopamine polymerization also allows introduction of other amine-terminated compounds during the polymerization reaction. In this work, we have compared two PDA-based coating techniques for fouling reduction – co-polymerization with amine-terminated polyethylene glycol (PEG-NH2) and ionic bonding of PDA with polyvinylpyrrolidone (PVP). [2] Presence of the function groups has been tested with Fourier-transformation IR spectroscopy (FTIR). Altered hydrophilicity of modified membranes has been evaluated with water drop contact angle measurements. Adsorption of model protein – bovine serum albumin (BSA) has been measured with bicinchoninic acid assay (BCA).

Acknowledgments

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Poster stand 10

Light-driven Actuation of Polycatecholamine Nanomembranes

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Nature-inspired materials that mimic muscle contractions have received tremendous scientific attention in recent years due to numerous potential applications in soft robotics, biomedicine, and tunable metamaterials. Among different strategies for the efficient conversion of energy contained in chemical or physical stimuli into macroscopic deformation, light-responsive materials appear as promising candidates to mitigate many current challenges. Foremost, light as a stimulus offers remote, spatial, and temporal control over actuation.

Here, we show that the light-to-motion conversion can be realized in polydopamine as well as other poly-catecholamines, including poly-levodopa, and poly-epinephrine. The freestanding membranes contract upon illumination and spontaneously expand in dark conditions. This reversible, light-triggered dynamics results from the desorption and absorption of water molecules which we confirm by exploiting temperature- and humidity-resolved microscopy and X-ray reflectivity techniques. Moreover, using Brillouin Light Scattering spectroscopy, the determined values of the Young modulus point to excellent elastic properties of the membranes and suggests their suitability for self-supporting applications. Our findings demonstrate that the poly-catecholamine membranes can be building blocks for soft, nanoscale actuators stimulated by light.

Acknowledgments

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Poster stand 11

Polydopamine/Graphene Oxide nanocomposite free-standing films – perspectives in phototcatalysis and electrochemistry

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The creation of Polydopamine free-standing films at the air/water interface occurs through either covalent or non-covalent self-assembly of the dopamine oxidation products. Introduction of Graphene Oxide into the structure of these films through disperion [1,2] and reduction to r-GO [2] may improve different essential properties of above mentioned films, i.e. conductivity, photoactivity.

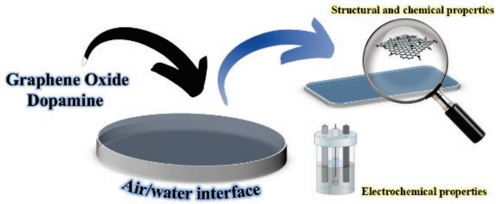

Fig. 1 Scheme presenting the stages of the experiment.

In this experiment the morphological and structural properties as well as the optical ones will be examinated, after the incorporation of Graphene Oxide into the Polydopamine free-standing films. The perspectives of its' usage in photocatalysis and electrochemistry will be explored.

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Poster stand 12

Preparation of Ultrathin and (Photo)degradable Polymeric Films by Electropolymerization of Dopamine Derivates

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Polydopamine (PDA) has attracted great attention due to its ability to adhere virtually to any surface and straightforward preparation method. PDA was found as a suitable candidate for various applications like coatings and biosensors thanks to its stability over a wide pH range as well as in several organic solvents and its easy functionalization methods. Recently, our group demonstrated the preparation of free-standing nanometer-thick films of PDA through electrodeposition using cyclic voltammetry (CV)1. This process led to polymeric films with controllable thickness [1], which are promising for applications ranging from photocatalysis [2] and biosensing [3] to nanofiltration. While PDA films have many beneficial properties, some limitations still exist, for example, their limited degradability and severe fluorescence quenching. Here, we explore the electropolymerization of dopamine-derived monomers to form polymeric films with novel properties to compensate for the drawbacks of PDA. First, poly(3-amino-L-tyrosine)4 films were prepared by CV and showed lower electrical resistance compared to PDA films as well as significantly reduced fluorescence quenching behaviour, making them an attractive alternative functionalization platform for biosensors. The second synthesized polymer was poly(nitrodopamine), which can undergo photodegradation under UV light irradiation (365 nm), enabling the possibility of controlled degradation and even photopatterning. These two new polymeric films will pave the way for the development of novel powerful functionalization platforms.

Acknowledgements

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Poster stand 13

Structure and Properties of Poly-2-aminomethyl-3-(3,4-dihydroxyphenyl)propionamide

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Synthesis of polydopamine analogues based on the monomers modified at the alkyl chain or at the terminal amine, presents interesting peculiarities regarding their polymerization mechanism or physical-chemical properties comparing with polydopamine. Their solubility in different solvents is a property that allows the investigation of additional properties such as fluorescence, which polydopamine does not have. Among these analogues Poly-2-aminomethyl-3-(3,4-dihydroxyphenyl)propionamide is a new polymer from the class of poly-catecholamines for which we could determine the optical properties in methanol obtaining a broad emission band in the 360-520 nm region followed by a shoulder in the 520-600 nm region with 4% quantum yield. In order to understand the mechanism of formation of these species responsible for fluorescence, and not only, selective isotopic labeling with ^{13}C and ^{15}N of the alkyl chain allowed us to determine a clearer structure in identifying the different monomeric units in the polymer matrix. The ability to coat surfaces is also an essential characteristic of these derivatives, where, for example, in the case of glass we obtained a thickness of ~70 nm almost double that of polydopamine in the same reaction parameters. Thus, Poly-2-aminomethyl-3-(3,4-dihydroxyphenyl)propionamide, based on the fundamental investigated physical-chemical properties, is, to be considered for other more advanced applications.

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Poster stand 14

Staudinger Reduction of Polydopaazide

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One of the most developing branches of catechol research is the synthesis of polydopamine analogues. These analogues can be obtained either by chemical functionalization of polydopamine-based materials or by polymerization of dopamine derivatives. [1,2] Such materials have found applications in medicine and environmental applications as well as catalysis [3-5]. Also, they are often an object of intensive structural studies. In the latest report of M. Szukowska et al., it has been presented that the azide derivative of dopamine can be polymerized resulting in polydopaazide [6]. Obtained materials were soluble in organic solvents, which allowed their detailed structural characterization by magnetic resonance spectroscopy and mass spectrometry. Here, we present research on exploiting a polydopaazide as starting material to obtain polydopamine-like material after its reduction under Staudinger reactions.

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Poster stand 15

Biofunctionality of curdlan hydrogel modified with silver nanoparticles via poly(L-DOPA) deposits

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Curdlan belongs to natural polymers, which after thermal gelation show flexibility and high water absorption capacity. However, chemical modifications aimed at increasing its functionality usually result in deterioration of mechanical parameters [1]. Our research team developed non-invasive curdlan hydrogel (CH) modification method based on introduction of catecholamine monomers (dopamine, L-DOPA) into CH before its thermal gelation (BG method). Poly(L-DOPA) deposits (PLDD) formed inside the hydrogel structure under the room temperature conditions and in the presence of atmospheric oxygen, enable binding of active molecules or functional particles within the hydrogel structure. This strategy was proven to functionalize CH by antibiotic molecules, oxidoreductases and ferrite nanoparticles without negative effect on matrix integrity and mechanical strenght [2,3,4].

Taking into account the urgent need to develop functional, antibacterial wound dressings, in light of dramatically increasing bacterial resistance to conventionally used antibiotics, we incorporated two forms of silver nanoparticles (NPs) (precipitates and triangles) into CH network via PLDD.

Such obtained stable tertiary hydrogels were nontoxic toward human dermal fibroblasts and showed high antibacterial acitivity as well as significant ability to convert energy with heat generation. The antibacterial experiments of tested matrices showed an enhanced antibacterial effect, especially when PLDD and silver NPs were simultanously used as a curdlan hydrogel modifiers. Some variants of material allowed for a balanced process of silver ions release from their structure, which may have a beneficial effect on the suitability of matrices in the healing processes of bacterial infected wounds. Moreover, they did not affect the clot formation process in comparison with negative control for this test.

Considering the advantageous mentioned above, PLDD-curdlan network enriched with AgNPs is a promising solution for creation of multi-task hydrogel for biomedical applications.

Acknowledgements

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Poster stand 16

Optimization of bio-inspired plastic metallization by spray deposition of polydopamine and palladium substitution

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Metallized plastics are highly valued, especially in the automotive industry and in the sanitary sector, because of their high-quality appearance combined with their low cost. Until now, these have been produced by etching with chromosulfuric acid, which is harmful to health and the environment. Using polydopamine (PDA) as a bio-inspired adhesion promoter, we have developed an environmentally friendly alternative for metallizing plastics.[1]

In order to make the plastic metallization with PDA suitable for industrial use, some steps still need to be optimized, such as the application method. Dip coating of substrates combined with the progressive polymerization of the dopamine requires large amounts of resources. The use of spray deposition of PDA reduces the consumption and further improves the environmental friendliness of the process.

Another aspect is the cost associated with the use of the precious metal palladium in the seeding step of the plastic metallization. In the conventional process, palladium has been established as the most cost-effective metal. The new process with PDA allows for potentially more economical alternatives. Of the elements that are fundamentally suitable for seeding, nickel was identified as the most cost-effective alternative to palladium. Various seeding processes using nickel were then investigated.[2]

Direct metallization can eliminate the seeding step altogether. For this purpose, it is necessary to prepare an initial conductive layer on the polymer substrate in order to subsequently build up the metal layers in the electroplating process. Initial experiments have been carried out on this topic.[2] By better understanding PDA deposition with different deposition methods and optimizing the metallization, a new environmentally friendly and cost-effective process can be developed for the industry.

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Poster stand 17

Nanoscale coordination polymers for cancer therapy

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Currently, the greatest challenge in cancer therapy, including Hepatocellular carcinom, is multi-drug resistance (MDR).[1] Resistance is demonstrated by cancer cells against any effective anticancer drug and may be triggered by several mechanisms which decrease the efficiency of cancer therapy. A promising category of nanomaterials emerging in nanomedicine are nanoscale coordination polymers (NCPs), that exhibit essential and unique characteristics as drug carriers, including high chemical tuneability, intrinsic biodegradation, and high drug loading capacity.[2]
In this study coordination polymers consisting of iron (II) ion, 1,4-Bis((1H-imidazol-1-yl)methyl)benzene (bix), and the catechol derivative of doxorubicin were obtained (NCP-1). Subsequently, the NCP-1 were coated with a biocompatible layer of silica (NCP-2) to prevent nanoparticles degradation. In the next step, NCP-2 were coated with polydopamine (PDA) layer (NCP-3) by oxidative polymerization of dopamine. PDA coating provides photothermal properties and allowed the attachment of a second drug – cisplatin (NCP-4) onto its surface. Obtained NCPs were characterized using the Scanning Electron Microscope (SEM) and infrared spectroscopy (IR). Also, their Zeta potential value, photothermal properties and toxicity were investigated.

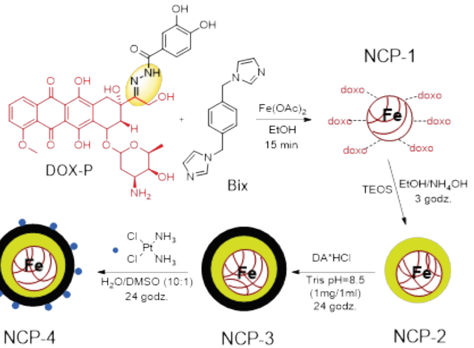

Figure 1. Synthesis of NCP-1, NCP-2, NCP-3 and NCP-4.

Acknowledgements

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Poster stand 18

Fabrication of a photothermal multifunctional platform based on spent coffee grounds and polydopamine

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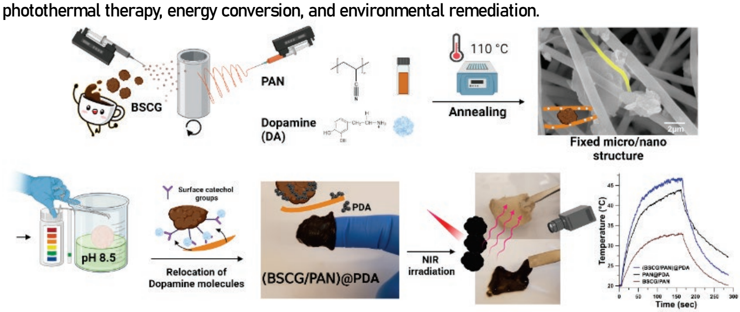
Every day, consuming two billion cups of coffee generates substantial waste known as spent coffee grounds (SCG), spurring interest in its utilization. SCG contains valuable compounds, including polyphenols, cellulose, and melanoidins, with intriguing photothermal properties due to broad light absorption. To overcome processing challenges and enhance material properties, a reliable approach involves bleaching SCG and introducing desired functional groups. Furthermore, incorporating SCG into a nanostructured substrate maximizes its photothermal potential by promoting efficient interaction and light absorption.

In this study, we prepared bleached SCG (BSCG) through a combo ball milling and washing process, reducing particle size and undesirable functional groups. Afterward, nanostructured composite mats were fabricated using simultaneous electrospinning and electrospraying techniques, integrating polyacrylonitrile (PAN), dopamine (PDA), and BSCG. Post-annealing fixed BSCG within nanofibrous structures. The mats were then transferred to Tris buffer to allow the formation of polydopamine. Although PAN nanofibers were the carriers of the dopamine molecules, the polydopamine particles surprisingly were formed around BSCG. A possible justification is that the remnant of the BSCG catechol groups enhances the absorption of dopamine. Therefore, the polymerization process was mainly localized around the BSCG microparticles ((BSCG/PDA)@PAN). Optimal photothermal properties were achieved with a 24-hour polymerization time. The composite exhibited improved functional groups and thermal stability, showcasing the potential of SCG and PDA for multifunctional platforms in various applications, including photothermal therapy, energy conversion, and environmental remediation.



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Poster stand 19

Super-elastic Free-standing Polydopamine Films for various applications

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Self-assembly of the polydopamine (PDA) molecular building blocks at the air/water interface follows two co-occurring pathways, namely covalent bonding or non-covalent physical interactions [1]. We achieved the control of this mechanism using oxidation agents, i.e. Cu2+ ions and boric acid.

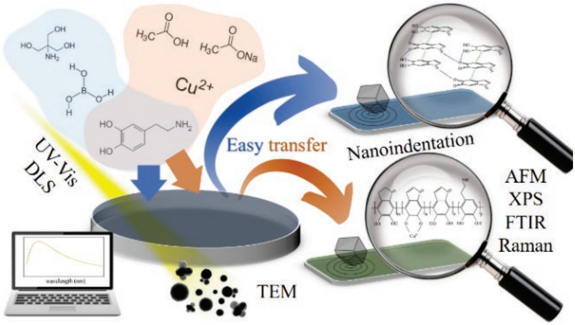

Figure 1. Schematic presentation of the experiment – nanoparticles and film growth observation with UV-Vis, DLS and SR, followed by examination of the structural, chemical and mechanical properties of the obtained films.

In this experiment, we have achieved exceptionally high control over the manufacturing process of the ultra-thin PDA free-standing films, i.e. a precise measurement of their growth dynamics in a real-time, reduction of , the possibility of synthesizing towards the chosen self-assembly mechanism and thus achieving desired mechanical properties, i.e. high Young's modulus.

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Poster stand 20

Composite based on polymeric blend of polyvinyl alcohol, curcumin, and polydopamine for wound healing applications.

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Polyvinyl alcohol has wound healing applications, and it presents excellent mechanical strength. Curcumin is polyphenol, and it holds anti-oxidative properties. Anti-oxidative properties of curcumin lead to early wound healing. Dopamine is biodegradable, but it has limitations due to its toxic effects. So, dopamine has been converted to polydopamine to be utilized in a polymeric blend by following the polymerization step. Polydopamine is highly applicable to be used as an adhesive, and in the form of coating. A polymeric blend of polyvinyl alcohol, curcumin, and polydopamine has been prepared. Polymeric films have been prepared following the solvent casting technique and/or a solvent evaporation method. Mechanical properties of the polymeric blend have been checked, and it presented excellent mechanical properties. Fourier Transform Infrared (FTIR) spectra of polymeric blends have been recorded. The addition of curcumin, and polydopamine to polyvinyl alcohol has modified the position of the peaks in FTIR spectra. Anti-oxidative properties of a polymeric blend of polyvinyl alcohol, curcumin, and polydopamine have been checked. Contact angle measurements have been performed to check the hydrophobicity and hydrophilicity of the polymeric blend. Surface energy has been calculated by utilizing drop-shape analyzer data.

Poster stand 21

Electrochemical deposition of hydroxylated and nitrogen containing molecules to obtain functional 2D materials

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Nowadays, nanosciences represent a major interest in the field of scientific research. These last years the number of studies on nanomaterials has considerably increased. Among 2D materials, graphene is a carbon-based material with numerous astonishing properties which are now well known in scientific research. [1] Graphene oxide presents also promising properties in many fields such as catalysis and energy storage, and the available hydroxylated groups allow to functionalize these kinds of materials. [2] However, graphene like materials despite their outstanding mechanical and electronical properties are not straightforward to be produced in environment-friendly conditions. [3] This is mandatory to use the amazing properties of this 2D material at optimal performance and at the lowest cost. As a perspective to obtain promising results, some recent evidence shows that oxidized graphene can be produced by electrochemical methods from aqueous solution of biomolecules like catechol. [4]

In this trend, we propose a direct, one pot and cheap strategy to design nitrogen-doped graphene oxide like materials from four isomers of dihydroxypyridine on glassy carbon and gold electrodes. We also demonstrate the effect of the precursor and the potential scan rate on the properties, notably the crystallinity of the obtained thin films.

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Poster stand 22

Dendrimer functionalized melanine-like nanoparticles for multimodal therapy of glioblastoma

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Glioblastoma belongs to the most aggressive and difficult to treat cancers. Traditional anti-cancer therapies are ineffective and life expectancy after diagnosis is only 12–18 months. Brain tumor cells overexpress a number of proteins that play a key role in tumor progression and can be used as therapeutic aim. A down-regulation of an extracellular matrix glycoprotein - tenascin-C (TN-C) by RNA interference (RNAi) seems to be a very promising approach in the treatment of cancer. However, the efficient delivery of naked double-stranded RNA (dsRNA) targeting TN-C sequence is problematic due to rapid degradation by nucleases and poor intracellular uptake. Polydopamine (PDA) nanoparticles modified with polyamidoamine (PAMAM) dendrimers may be used as a vehicle for gene/drug delivery. PDA, a nature-inspired polymer, is characterized by high biocompatibility and a facile functionalization process. Furthermore, the photothermal features of this polymer enable its application in photothermal therapy (PTT), which is an excellent option for cancer treatment.

The goal of this study was to synthesize and characterize PDA nanoparticles (NPs) functionalized with PAMAM dendrimers for therapeutic dsRNA and DOX delivery. PDA@PAMAM NPs could be further used in combined drug-, gene and photothermal therapy. NPs were characterized in terms of physicochemical and photothermal properties as well as their cytotoxic effect using human U118-MG cell line derived from a glioblastoma multiforme was assessed. The results demonstrate that the synthesized NPs may be potential nanocarriers for dsRNA as well as DOX delivery and as photothermal agents for PTT in glioma treatment.

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Poster stand 23

Characterization of size-dependent changes in the cytotoxicity of poly-dopamine nanoparticles.

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One of the biggest challenges facing cancer biology nowadays is the development of new safe carriers that can transport therapeutics inside tumour cells. In the past fewyears nanoparticles have become a prime candidate for a new drug and RNA delivery system to human cells. In most cases they seem to be non-toxic to cells by direct contact as well as after internalization to cellular matrix.

The study of the impact on living cells cannot be conducted in isolation from the physical properties of these materials. One of the most important properties of nanoparticles is their nanometric size. Previously published studies have demonstrated the influence of nanoparticle size on their pharmacokinetics and ability to interact with cells. In the studies presented in this work, the viability of cells treated with polymer nanoparticles of various sizes was examined. For this purpose, single-component polymer particles made of polydopamine (PDA) were used - a biomimetic polymer obtained for the first time in 2007.[1] This material is widely used in nanotechnology, mainly for the production of nanoparticles. [2,3] Polymer nanoparticles made of polydopamine come in a wide spectrum of single particle sizes. As part of my doctoral thesis, I used PDA nanoparticles in three different sizes - 100nm, 140nm and 240nm.

The aim of the presented study was therefore to determine the cytotoxic properties of nanoparticles depending on their size in human cell lines of various types, with particular emphasis on cancer cells. Four cell lines were used: U-118-MG of glioma origin, MRC-5 - a line of embryonic lung fibroblasts, HEK-293 - an immortalized line of embryonic kidney cells, and HEP G2 - a tumor line derived from hepatocellular carcinoma.

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Poster stand 24

Ultrathin polydopamine membranes for efficient ion and molecular sieving

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Selective ion and molecular transport across membranes with high permeability is of broad interesting in nanofluidics[1], flow batteries[2], biosensing[3], desalination[4], energy conversion[5] and other applications. Membranes with sub-2-nanometer channels allow fast ion transport, but it remains an extremely challenging task to design such membranes with desirable ion sieving performance. Biological membranes, owing to the existence of (sub-)nanometer protein channels and channel wall chemistry, show marvelous ion transport properties, which give us an excellent inspiration for membrane designation[6]. Herein, ultrathin polydopamine (PDA) membrane using an easy to scale-up electropolymerization strategy with sub-2-nanometer channels, pH responsivity and abundant hydrogen bonding sites owing to the presence of amine groups and phenolic hydroxyl groups, exhibiting precise ion sieving properties are demonstrated. The advent of freestanding PDA membranes based on electropolymerization provides a fast route towards developing (sub-)-nanometer sized membrane with controlled thickness, and therefore offer it the potential for a wide range of challenging separation needs.

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Poster stand 25

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Table of contents

Wednesday 11.10.2023

8:00-9:00 REGISTRATION

9:00-9:30 OPENING CEREMONY

9:30-10:15 Daniel Ruiz-Molina
"Catechol-Based Nanostructures In Medicine"

10:15-11:00 Tomasz Ciach
"Oxidative Polymerization Of Various Phenylamines For Medical Coatings"

11:00-11:30 COFFEE BREAK

11:30-12:15 Anna Belcarz
"Natural Polymers - Matrices for Polycatecholamine Coating"

12:15-13:00 Radosław Mrówczyński
"Chemistry of Nanoscale Polydopamine-Based Materials"

13:00-14:00 LUNCH

14:00-14:30 GROUP PHOTO

14:30-15:15 Vincent Ball
"Oxidized Dopamine, Polyphenols and Aminomalononitrile: From Functional Hydrogels to Graphene Oxide Like Materials"

15:15-16:00 Maria Laura Alfieri
"Novel Strategies for Polydopamine Site-Specific Deposition and Catechols/Diamines Bioactive Coatings Implementation"

16:00-16:45 Cordelia Zimmerer
"Polydopamine-Mediated Materials Adhesion of Plastics and Metal – Key To Ecofriendly Material Design And Processing"

16:45-17:00 BREAK

17:00-18:00 POSTER SESSION

Thursday 12.10.2023

9:00-9:45 Jürgen Liebscher
"Modifying The Structure Of Dopamine – Consequences To Polymer Formation"

9:45-10:30 Emerson Coy
"Possible Supramolecular Ordering in Polydopamine Film"

10:30-11:00 COFFEE BREAK

11:00-11:45 Christopher V. Synatschke
"Ultrathin Films And Self-Standing Membranes From Polydopamine: A New Material For Photocatalysis, Biosensors, And Water Filtration "

11:45-12:30 Bartłomiej Graczykowski
"Mechanical And Thermal Engineering Of Functional Nanomembranes"

12:30-13:15 Yeonho Kim
"Design Of Polydopamine-Semiconductor Nanocomposites For Energy Application"

13:15-14:15 LUNCH

14:15-14:45 CLOSING CEREMONY

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