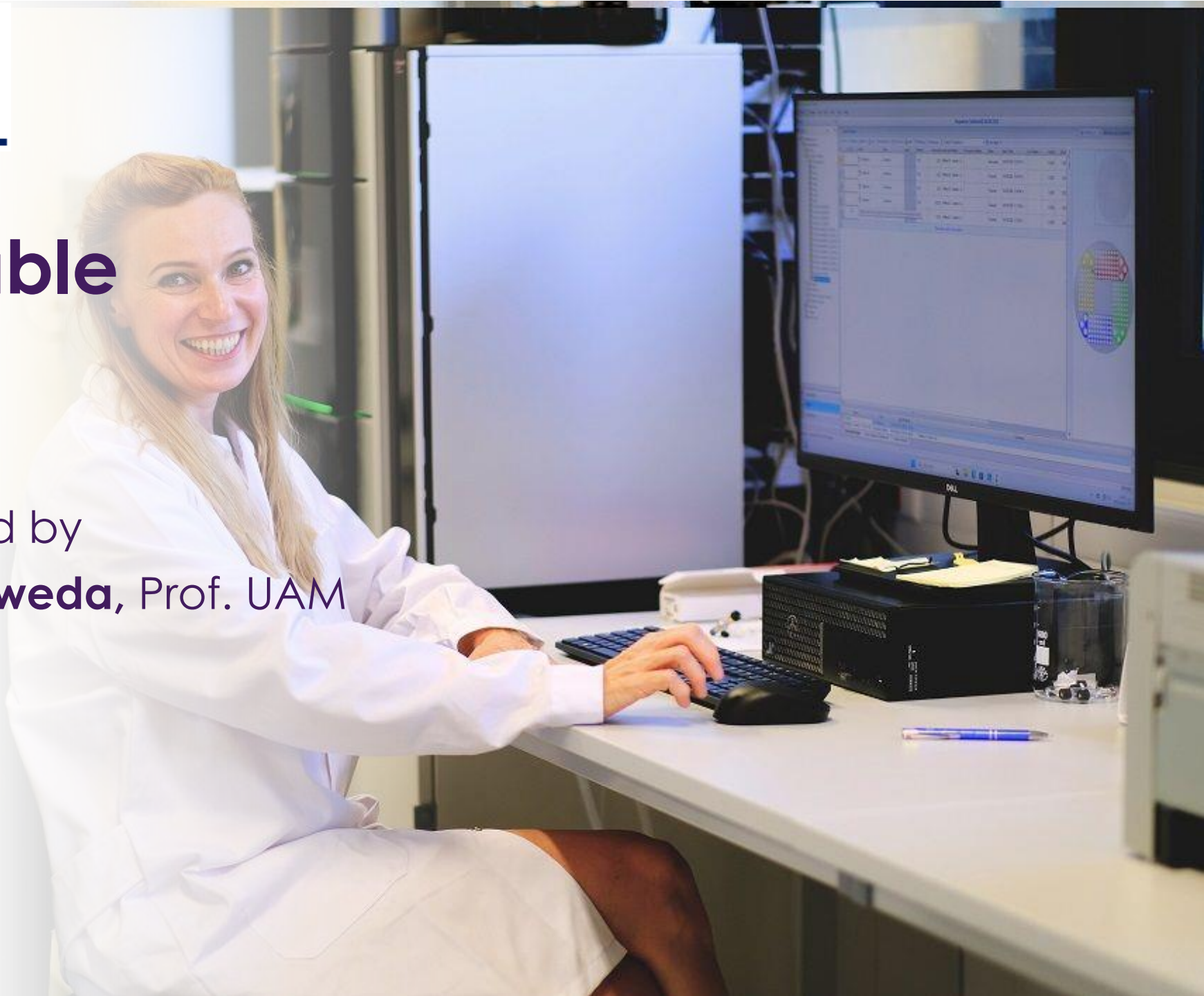
Adam Mickiewicz University Poznań Poland

Center for Advanced Technologies

Programmable Polymers Laboratory

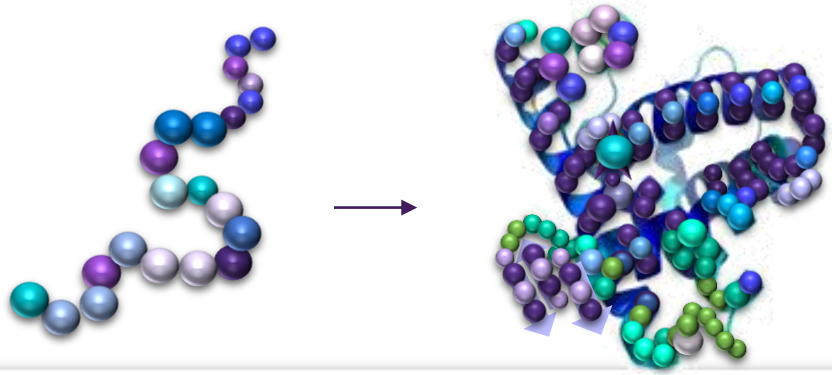
Research Group led by

dr hab. inż. **Róża Szweda**, Prof. UAM



PROGRAMMABLE POLYMERS LABORATORY

Shape the Future of Materials with Us!



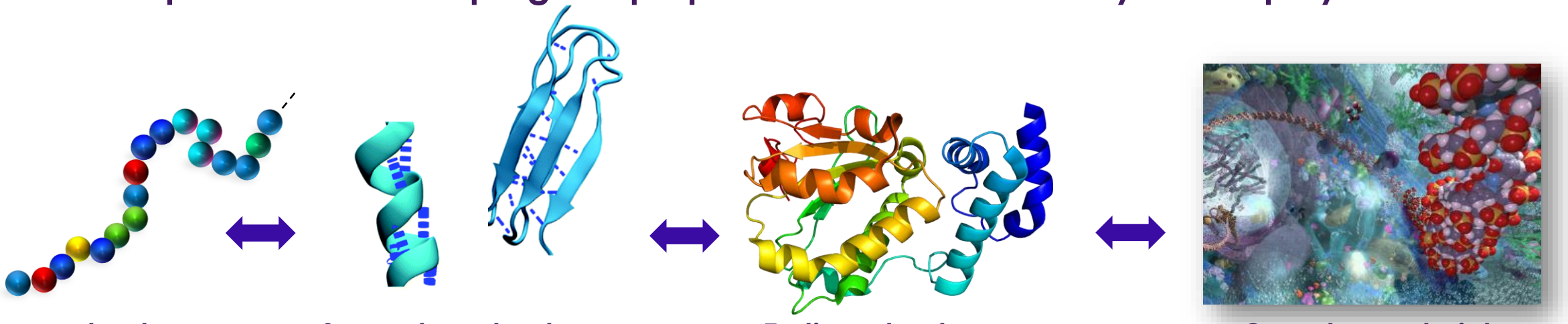
Useful definitions:

- Sequence-defined polymers: polymers with a strictly predefined monomer sequence and exact molar mass
- Stereo-controlled polymers: polymers with a strictly predefined arrangement of stereocenters

We invite students for internship program to be involved in cutting-edge research projects

What We Do?

We use sequence control to program properties and functions of synthetic polymers

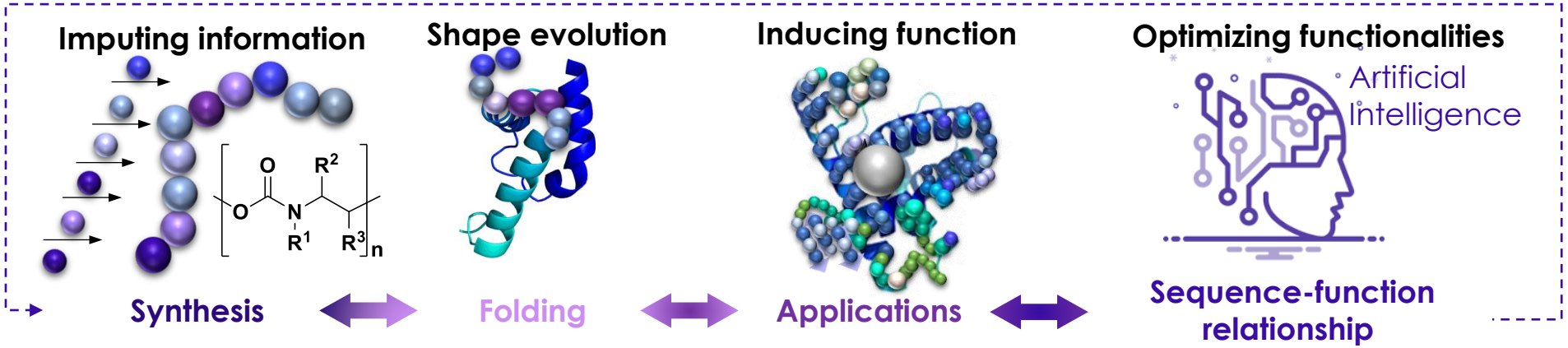


Primary structure | Secondary structure | Tertiary structure | Complex materials

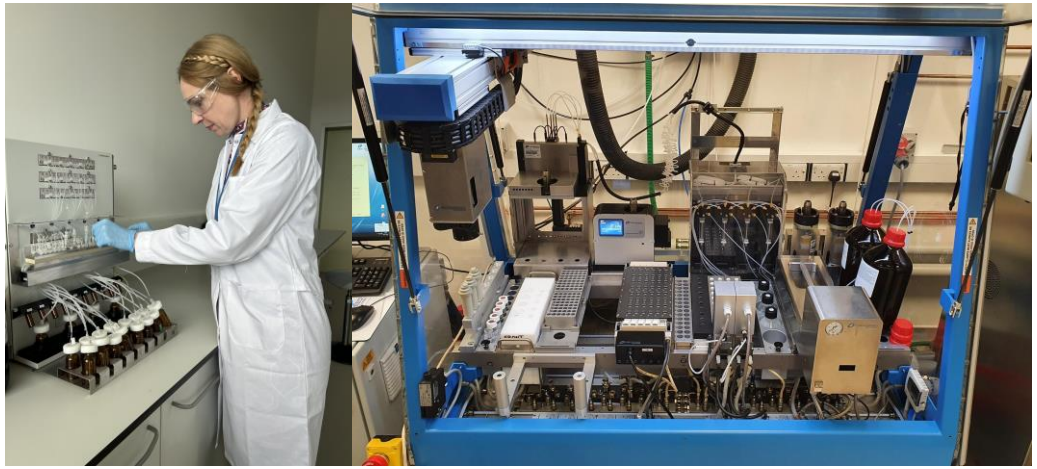
Key Research Areas:

- Synthesis of **sequence-defined polymers**
- Developing polymers with **precisely controlled sequences and structures**
- **Study of sequence-property relationship**
- Applications: **data storage, drug delivery, catalysis**, **sensing** and more

How Do We Programme Functions Into Polymers?



Automated syntheses & analyses to facilitate discovery



Our methodology: Programming Functions with AI

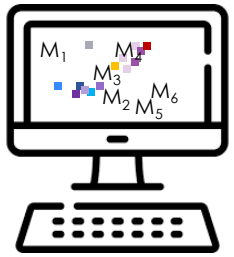
Sequence-function relationship

Automated experiments
High-throughput analysis

Sequence-function data

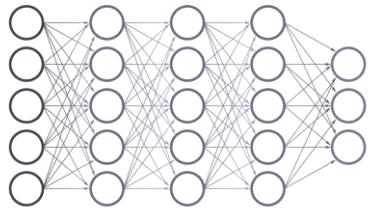
$M_1M_2M_1M_2(\ldots)M_1M_4$ 20%
$M_1M_2M_1M_2(\ldots)M_1M_4$ 16%
$M_1M_2M_1M_2(\ldots)M_1M_4$ 76%
(…)
$M_1M_2M_1M_2(\ldots)M_1M_4$ 18%

Data description



Properties

Neural networks



Predicted data

$M_1M_2M_1M_2(\ldots)M_1M_4$ **10%**
$M_1M_2M_1M_2(\ldots)M_1M_4$ **36%**
$M_1M_2M_1M_2(\ldots)M_1M_4$ **98%**
(…)

Validation loop

Why Machine Learning?

- Helps decode complex relationships between polymer **sequence, structure, and function**.
- Enhances the prediction of **material behaviors** and **properties**.

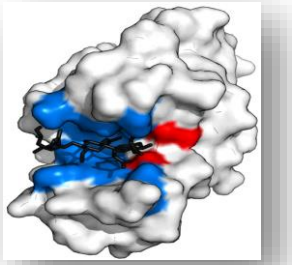
Research Projects

European Research Council
Established by the European Commission

ERC Starting Grant: No 101116700

SHAPE - Abiotic enzymes

Artificial enzymes with the precision and power of nature – but without the limitations! Imagine catalysts that work beyond water and physiological conditions.



NATIONAL SCIENCE CENTRE
POLAND

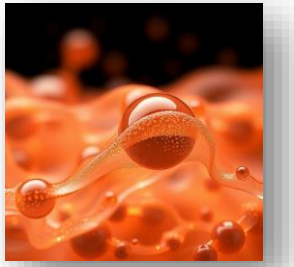
Sonata BIS: No 2021/42/E/ST4/00010

PolyDigit -Data storage

Unlock the Code: Store binary (or any) information directly in the sequence of monomers! Join us in tackling the future of data storage, together.

OPUS LAP: No 2021/43/I/ST4/01294

MimicLS - Life-like materials



Custom-designed macromolecules with powerful properties: imagine flexibility, self-healing, antimicrobial action, and more! In MimicLS we make new materials with functions mimicing mnatural matter.

The National Centre
for Research and Development

LIDER/27/0148/L-12/20/NCBR/2021

PolySens - sensors

Precision polymers that respond to their surroundings: adaptable properties triggered by environmental changes or specific molecules!

szwedalab.com

Our team

PROGRAMMABLE POLYMERS LABORATORY

Dr. Róża Szweda
Dr. Krzysztof Zwoliński
Dr. Siyasanga Mbizana

Weronika Forysiak
Maksymilian Szatko
Kasper Witruk
Wojciech Dudziak

We are recruiting PhD students and Post-docs!

Key collaborators:

UNIVERSITÉ DE GENÈVE

Takuji Adachi & Thomas Buergi, Ariel Perez Mellor (DFT, VCD)

Wrocław University of Science and Technology

Tadeusz Andruniów (MD)

UNIVERSITY OF CAMBRIDGE
Yusuf Hamied Department of Chemistry

Paweł Dydio, Yang Zhang (catalysis)

We welcome all motivated students!

PROGRAMMABLE
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If you are interested in joining our team, send your resume to **szwedalab@gmail.com**

We invite you to visit our social media channels:

szwedalab.com