# Creating synthetic polymers with biological precision for future biotechnologies

***Róża Szweda***

***Center of Programmable Polymers***

***Adam Mickiewicz University***

Natural macromolecules like proteins and nucleic acids perform a vast array of functions in biological systems, thanks to their carefully defined sequences and stereochemistry. Recent breakthroughs in polymer science now allow us to bring this level of precision to synthetic polymers, opening up new possibilities for mimicking the complex functionality of biopolymers [1]. Sequence control of polymer structure opens new avenues for designing biomimetic macromolecules with functionalities similar to those of living matter, thereby expanding the potential applications of synthetic polymers across various fields of biomedical nanotechnologies.

This work introduces a novel approach to synthesizing polymers based on natural amino acids, achieving precise sequence and stereochemical control through one-pot synthesis and iterative growth techniques. Our research reveals how sequence-defined polymers can adopt secondary structures and assemble into sophisticated, temperature-responsive materials—much like their natural counterparts [2].

By engineering these biomimetic polymers, we're unlocking potential applications across fields from drug delivery to tissue engineering, bringing us closer to materials that emulate the dynamic functionality of biological systems.

1. Laurent, E., Szweda R., Lutz, JF. Synthetic Polymers with Finely Regulated Monomer Sequences: Properties and Emerging Applications. In Macromolecular Engineering (eds N. Hadjichristidis, Y. Gnanou, K. Matyjaszewski and M. Muthukumar). 2022, pp 1–34. N. F. König, A. Al Ouahabi, L. Oswald, R. Szweda, L. Charles, J.-F. Lutz Nat Commun 2019, 10, 3774.

2. Szweda, R. Sequence- and stereo-defined macromolecules: properties and emerging functionalities Prog Polym Sci, 2023, 145, 101737.