Biophysical Chemistry Group

HEAD:

Prof. Wojciech Dzwolak*, PhD DSc

GROUP MEMBERS:

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MSc students: Mateusz Fortunka, Małgorzata Jabłońska

RESEARCH PROFILE:

Our research is focused on biological soft matter: its dynamics, conformational transitions, and processes leading to the hierarchical self-assembly of biopolymers and biomembranes. We are particularly interested in:

- mechanisms of protein aggregation,
- borderlines between determinism and randomness in conformational transitions of proteins,
- thermodynamics of protein folding and misfolding,
- applications of the biological self-organization in nanotechnology,
- biological applications of optical spectroscopy.

CURRENT RESEARCH ACTIVITIES:

1. Biophysical experimental and theoretical studies on the H-fragment of insulin – the newly identified highly amyloidogenic two-chain fragment of the hormone (Piejko M et al J. Biol. Chem. 290 (2015) 5947):

2. A multidisciplinary approach to the self-assembly of nanofibrils from short synthetic peptides: from the identification of fundamental driving forces of the phenomenon to future applications in material sciences and clinical diagnostics.

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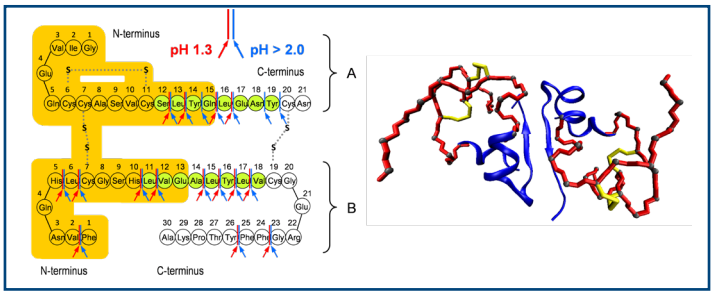

Fig. 1. The orange-marked covalent structure of the H-fragment is indicated within the primary sequence of bovine insulin monomer (left panel) and 3D-structure of the dimer (right side – red tubes).

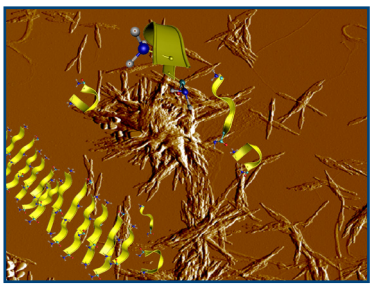

Fig. 2. AFM amplitude image of beta2-type fibrils self-assembled from short oligomers of L-glutamic acid (according to Hernik-Magoń A et al, *Colloid. Surface. B* 159 (2017) 861).

SELECTED PUBLICATIONS:

1. A. Hernik-Magoń, W. Puławski, B. Fedorczyk, D. Tymecka, A. Misicka, P. Szymczak, W. Dzwolak, Beware of cocktails: Chain-length bidispersity triggers explosive self-assembly of poly-L-glutamic acid β2-fibrils, Biomacromolecules. 17 (2016) 1376–1382.
2. M. Piejko, R. Dec, V. Babenko, A. Hoang, M. Szewczyk, P. Mak, W. Dzwolak, Highly amyloidogenic two-chain peptide fragments are released upon partial digestion of insulin with pepsin, J. Biol. Chem. 290 (2015) 5947–5958.
3. W. Surmacz-Chwedoruk, H. Nieznańska, S. Wójcik, W. Dzwolak, Cross-seeding of fibrils from two types of insulin induces new amyloid strains, Biochemistry. 51 (2012) 9460–9469.
4. V. Babenko, W. Dzwolak, Thioflavin T forms a non-fluorescent complex with α-helical poly-L-glutamic acid, Chem. Commun. 47 (2011) 10686–10688.
5. A. Fulara, A. Lakhani, S. Wójcik, H. Nieznańska, T.A. Keiderling, W. Dzwolak, Spiral superstructures of amyloid-like fibrils of polyglutamic acid: An infrared absorption and vibrational circular dichroism study, J. Phys. Chem. B. 115 (2011) 11010–11016.
6. A. Loksztejn, W. Dzwolak, Vortex-induced formation of insulin amyloid superstructures probed by time-lapse atomic force microscopy and circular dichroism spectroscopy, J. Mol. Biol. 395 (2010) 643–655.
7. W. Dzwolak, A. Loksztejn, A. Galińska-Rakoczy, R. Adachi, Y. Goto, L. Rupnicki, Conformational indeterminism in protein misfolding: chiral amplification on amyloidogenic pathway of insulin, J. Amer. Chem. Soc. 129 (2007) 7517-7522.
8. W. Dzwolak, R. Ravindra, C. Nicolini, R. Jansen, R. Winter, The diastereomeric assembly of polylysine is the low-volume pathway for preferential formation of beta-sheet aggregates, J. Amer. Chem. Soc. 126 (2004) 3762-3768.
9. W. Dzwolak, T. Muraki, M. Kato, Y. Taniguchi, Chain-length dependence of alpha-helix to beta-sheet transition in polylysine: model of protein aggregation studied by temperature-tuned FTIR spectroscopy, Biopolymers. 73 (2004) 463-469.