

**BIOGRAPHICAL SKETCH**

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NAME: Nawrocka, Wioletta

eRA COMMONS USER NAME: WIOLANAWROCKA

POSITION TITLE: Ph.D. Candidate

**EDUCATION/TRAINING**

INSTITUTION AND LOCATION	DEGREE	Start Date MM/YYYY	Completion Date MM/YYYY	FIELD OF STUDY
Wroclaw University of Science and Technology, Wroclaw, Poland	BSc	10/2009	01/2013	Biotechnology
Wroclaw University of Science and Technology, Wroclaw, Poland	MSc	03/2013	10/2015	Molecular Biotechnology and Biocatalysis
The University of Chicago, Chicago, IL	Ph.D.	09/2017	Current	Biochemistry and Molecular Biophysics

**A. Personal Statement**

I am a Ph.D. student in the Molecular Neurobiology lab led by Dr. Engin Özkan. My work focuses on understanding the molecular basis of neurodevelopment and neurological disorders using biochemistry, biophysics, and structural biology. My career goals include becoming a post-doctoral researcher and, ultimately, a Principal Investigator studying the molecular mechanisms of neuroregeneration, neurodegenerative diseases, and disorders caused by defects in the nervous system wiring. I am a first-generation college graduate from Poland. I arrived in the United States as a visiting Master's student within the Fulbright BioLAB program and joined the Molecular Immunology lab led by Dr. Erin Adams at the University of Chicago. During that time, and later, as a Research Specialist in Dr. Adams' team, I studied the structure and function of the proteins involved in recognizing infected and transformed cells, and the immune tolerance processes. Work on multiple projects helped me advance my organization skills, master molecular cloning strategies, protein biochemistry, and cell culture. The research in Dr. Adams' laboratory was particularly interesting to me due to the therapeutic potential of the findings. I realized the importance of studying the protein-protein interactions and multi-protein complexes for a comprehensive understanding of human health and disease states. As a Ph.D. student, I expanded my interests into the nervous system. I joined the laboratory of Dr. Özkan, an expert in structural biology and biophysics of cell surface proteins involved in the nervous system's wiring. The research mentioned in this application is a part of my thesis project focusing on the recently discovered direct interaction between two molecular pathways: the network of neuronal cell adhesion receptors and the evolutionarily conserved signaling pathway involved in processes of neural differentiation, growth, and regeneration. I plan to describe the interplay between these pathways and contribute to the field of neurodevelopment and neuroregeneration. The training with the guidance from Dr. Özkan and support from his established network of collaborators at the University of Chicago and beyond will allow me to master the methods of structural biology, biophysics, and cell biology. I will learn Surface Plasmon Resonance for studying protein-protein interactions, X-ray crystallography and cryo-electron microscopy for protein structure determination, yeast display for protein engineering, and cell-based signaling assays and flow cytometry for functional studies. The training will shape me into a better candidate for post-doctoral positions and leave me better prepared to achieve my long-term career goals. As a Principal Investigator, I would like to focus on increasing the diversity among researchers and serve as a mentor, especially for students who suffered from the socioeconomic disadvantage. I believe that my scientific and professional interests, unwavering commitment to research, perseverance, and the conscious mentorship that I have received make me a strong candidate for an impactful future contributor in the field of the molecular biology of human disease.

## B. Positions and Honors

### Positions

2014 – 2015 Graduate Research Assistant, Fulbright BioLAB Program, The University of Chicago  
2015 – 2017 Research Specialist/Lab Manager, The University of Chicago

### Honors

2009 – 2010 Mathematical Scholarship, President of Wroclaw, Poland  
2009 – 2012 Scholarship from European Social Fund, Wroclaw University of Science and Technology  
2010 – 2012 Scholarship for Academic Performance, Wroclaw University of Science and Technology  
2012 – 2013 Rector's Scholarship, Wroclaw University of Science and Technology  
2018 – 2019 2<sup>nd</sup> Year International Fellowship, The University of Chicago, Biological Sciences Division

### Memberships

2017 – 2019; 2020 – current The New York Academy of Sciences  
2018 – current Society for Neuroscience  
2020 – current American Heart Association

## C. Contributions to Science

Two of the projects I worked on during my time in Dr. Adams' lab resulted in publication of peer-reviewed articles that extended the knowledge on the antigen recognition by human immune cells.

### Studies of the conformational states of the human butyrophilin 3 in V $\gamma$ 9V $\delta$ 2 T cells stimulation

Transmembrane protein butyrophilin 3 (BTN3) is required for the phosphoantigen-mediated activation of the non-canonical V $\gamma$ 9V $\delta$ 2 T cells. In 2015 I co-authored a review article, in which we summarize the findings that have shed light on this process. Dr. Adams' team had recently solved the crystal structures of the extracellular domains of BTN3 and observed two dimeric states of the protein. I sought to address whether the conformations observed in the crystal structures could be adopted in the context of the full-length protein, and whether they were associated with different functional states of the protein. I purified the three existing isoforms of BTN3 and reconstituted them into nanodiscs that mimic the natural lipid bilayer. During the optimization process I observed hetero-oligomerization between different BTN3 isoforms of potential physiological importance, which had not been previously reported. The negative stain electron microscopy on the proteins in the nanodiscs, performed by collaborators at the University of Michigan, showed that the full-length BTN3 can indeed exist in the membrane in one of the dimeric forms observed in the crystal structures. These findings have enabled biochemical and biophysical studies, aiming to directly test whether the phosphoantigen binding induces the conformational change of the BTN3 that can be recognized by V $\gamma$ 9V $\delta$ 2 T cells.

**Nawrocka, W. I., & Adams, E. J.** (2014, October 31). *Investigation of oligomeric conformational states of full-length human butyrophilin (CD277) and their implications in V $\gamma$ 9V $\delta$ 2 T cells stimulation* [Poster session]. The University of Chicago Molecular Biosciences Annual Retreat, Galena, IL, United States.

Gu, S., **Nawrocka, W.**, & Adams, E. J. (2015). Sensing of pyrophosphate metabolites by V $\gamma$ 9V $\delta$ 2 T cells. *Frontiers in Immunology*, 5: 688, 1-10. doi: <https://doi.org/10.3389/fimmu.2014.00688>.

Gu, S., Sachleben, J. R., Boughter, C. T., **Nawrocka, W. I.**, ..., Skiniotis, G., Roux, B., Adams, E. J. (2017). Phosphoantigen-induced conformational change of butyrophilin 3A1 (BTN3A1) and its implication on V $\gamma$ 9V $\delta$ 2 T cell activation. *PNAS*, 114(35), E7311-E7320. doi: <https://doi.org/10.1073/pnas.1707547114>.

### Studies of the structural mechanism of the recognition of self-antigen-MHC by regulatory T cells

Regulatory T cells (Tregs) are a subset of lymphocytes with a huge therapeutic potential. The ability to stimulate these cells could help to increase the immune tolerance desirable in the case of autoimmunity; conversely, blockade or depletion of Tregs in tumor could enhance the anti-cancer immune response initiated by conventional T cells. To effectively employ these strategies, it is crucial to characterize the activation process, mediated by the interactions between Treg T cell receptors and cognate major histocompatibility complex (MHC) molecules. This had been extremely challenging, however, as the self-antigen-MHC complexes recognized by

naturally occurring Tregs remained at that time virtually unknown. I worked with John Leonard, a postdoc in Dr. Adams' lab, who had recently identified the self-antigen recognized by thymic-derived Tregs, originally isolated from mouse prostate tumors. I have contributed to protein engineering and expression optimization efforts for the relevant peptide-MHC molecules. Using these peptide-MHC proteins, we made fluorescently labeled protein tetramers, which our collaborators used to detect self-antigen specific Tregs in mouse models of prostate cancer and prostatic autoimmunity. These discoveries constituted a major breakthrough in Treg biology. They enabled biophysical and structural studies of the self-antigen-MHC recognition by Tregs, and further investigation of their immunological functions.

Leonard, J. D., Gilmore, D. C., Dileepan, T., **Nawrocka, W. I.**, ..., Jenkins, M. K., Adams, E. J., Savage, P. A. (2017). Identification of natural regulatory T cell epitopes reveals convergence on a dominant autoantigen. *Immunity*, 47(1), 107-117.E8. doi: <https://doi.org/10.1016/j.immuni.2017.06.015>.

## **D. Additional Information: Research Support and/or Scholastic Performance**

### **Scholastic Performance**

Explanation of the grading system at Wroclaw University of Technology in Poland:

5.5 – A+; 5.0 – A; 4.5 – B+; 4.0 – B; 3.5 – C+; 3.0 – C; < 3.0 – F

YEAR	COURSE TITLE	GRADE
<b>Wroclaw University of Science and Technology – Undergraduate Courses</b>		
2009	Biology I	3.0
2009	Technical Principles of Biotechnology	4.5
2009	Technical Principles of Biotechnology – Discussion	4.5
2009	General Chemistry	4.5
2009	General Chemistry – Discussion	4.0
2009	Physics I	3.0
2009	Physics I – Discussion	3.5
2009	Algebra and Analytic Geometry	3.0
2009	Algebra and Analytic Geometry – Discussion	3.0
2009	Mathematical Analysis 1.1 B	4.5
2009	Mathematical Analysis 1.1 B – Discussion	4.5
2009	Information Technology – Laboratory	4.5
2010	Biology II	4.0
2010	Biology II – Laboratory	4.5
2010	Genetics	4.5
2010	Fundamentals of Inorganic Chemistry	3.5
2010	Fundamentals of Inorganic Chemistry – Laboratory	5.0
2010	Physics II	5.0
2010	Physics II – Discussion	5.0
2010	Physics II – Laboratory	5.0
2010	Mathematical Analysis 2.2 B	5.0
2010	Mathematical Analysis 2.2 B – Discussion	5.0
2010	Environmental Protection	3.5
2010	Environmental Protection – Seminar	5.5
2010	Biochemistry I	4.5
2010	Biochemistry I – Discussion	4.0
2010	Fundamentals of Physical Chemistry	5.5
2010	Principles of Organic Chemistry	4.0
2010	Principles of Organic Chemistry – Laboratory	4.5
2010	Physical Chemistry – Laboratory	5.0
2010	Fundamentals of Chemical Engineering	3.0

YEAR	COURSE TITLE	GRADE
2010	Chemical Engineering – Discussion	5.0
2010	English B2	5.0
2011	Organic Chemistry - Laboratory	5.5
2011	Chemical Engineering – Laboratory	5.0
2011	Fundamentals of Analytical Chemistry	4.5
2011	Fundamentals of Analytical Chemistry – Laboratory	5.0
2011	Biochemistry II	5.0
2011	Biochemistry II – Discussion	4.5
2011	Microbiology	3.5
2011	Microbiology – Laboratory	4.5
2011	Fundamentals of Chemical Engineering	4.5
2011	Modern Philosophy	5.0
2011	Research - Laboratory	5.0
2011	Molecular Biology - Seminar	5.5
2011	Biomaterials	5.0
2011	Industrial Microbiology	4.0
2011	Industrial Microbiology – Laboratory	4.5
2011	Bioreactor Engineering	4.0
2011	Biotechnology	3.0
2011	Molecular Biology	5.0
2011	Trends in Biotechnology	5.0
2011	Biochemistry – Laboratory	5.0
2011	Biophysics	5.0
2012	Enzymology – Laboratory	5.5
2012	Genetic Engineering – Laboratory	5.5
2012	Bioreactor Engineering – Laboratory	4.0
2012	Metrology in Chemistry and Analytical Chemistry	5.5
2012	Biotechnological Methods in Environmental Protection	5.0
2012	Biotechnological Methods in Environmental Protection – Laboratory	4.5
2012	Microbial Biotransformations	5.0
2012	Genetic Engineering	4.0
2012	Bioprocess Engineering	4.5
2012	Isolation and Purification of Bioproducts	4.5
2012	Engineering Project I – Laboratory	5.5
2012	Fundamental of Bioinformatics – Laboratory	4.5
2012	Tissue Culture	5.0
2012	Tissue Culture – Seminar	5.5
2012	Work Safety and Ergonomics	4.5
2012	Protection of Intellectual and Industrial Property	5.0
2012	Isolation and Purification of Bioproducts – Laboratory	5.0
2012	Engineering Project II – Laboratory	5.5
	<b>Wroclaw University of Science and Technology – Master's Courses</b>	
2013	Bioprocesses - Project	4.5
2013	Biotransformations – Laboratory	5.0
2013	Chemistry of Natural Products – Laboratory	4.0
2013	Chemistry of Natural Products	5.5
2013	Elements of Bioinformatics	5.5
2013	English B2+	5.0
2013	Enzyme Technology	4.5

YEAR	COURSE TITLE	GRADE
2013	German A2	5.0
2013	Mathematical Modeling of Biotechnological Processes – Laboratory	5.5
2013	Metabolomics – Seminar	5.0
2013	Metabolomics	4.5
2013	Methodology of Experimental Research	5.0
2013	Research – Laboratory	5.5
2013	Scientific and Technical Information – Laboratory	5.5
2013	Bioinformatics – Laboratory	5.0
2013	Bioorganic Chemistry – Laboratory	5.5
2013	Bioorganic Chemistry – Seminar	5.5
2013	Bioorganic Chemistry	5.5
2013	Design of Biologically Active Compounds – Project	5.0
2013	Design of Biologically Active Compounds	5.0
2013	Enzyme Technology – Laboratory	5.5
2013	Introduction to Statistics	5.0
2013	Modern Trends in Management	4.5
2013	MSc Thesis I – Project	5.5
2013	Philosophy of Science and Technology	5.0
2013	Relationships in Ecosystems	4.5
2014	Economy and Organization in Industrial Biotechnology	3.0
2014	Ethical Aspects of Biotechnology	5.5
2014	MSc Thesis II – Project	5.5
2014	Optimization of Biotechnological Processes	5.5
2014	Optimization of Biotechnological Processes – Project	5.0
<b>The University of Chicago – Ph.D. Courses</b>		
2017	Chemical Biology I	B
2017	BSD Quantitative Biology Bootcamp	P
2017	Introduction to Research	P
2017	Current Seminar Topics in Biochemistry & Molecular Biology	P
2017	Cell Biology I	A-
2017	Protein Fundamentals	A
2018	Responsible, Rigorous, and Reproducible Conduct of Research: R3CR	P
2018	Research Rotation I	P
2018	Molecular Biology I	B
2018	Evolution of Biological Molecules	P
2018	Research Rotation II	P
2018	Biophysics of Biomolecules	B
2018	Current Seminar Topics in Biochemistry & Molecular Biology	P
2018	Intro to Research: BCMB	P
2018	X-Ray Crystallography and Cryo-Electron Microscopy	A
2020	Teaching Assistant Training	P
2020	Teaching Assistantship	In progress