BIOGRAPHICAL SKETCH

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NAME: Movileanu, Liviu

eRA COMMONS USER NAME (credential, e.g., agency login): lmovilea

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Bucharest	B.S.	06/89	Physics
University of Bucharest	M.S.	06/90	Polymer Physics
University of Bucharest	Ph.D.	04/97	Biophysics
University of Missouri-Kansas City	Postdoc	10/98	Biochemistry & Biophysics
Texas A&M University Health Science Center	Postdoc	08/04	Biochemistry & Biophysics

B. Positions and Honors

B1. Positions and Employment

1991-1995 *Teaching Assistant* and *Graduate Student*, University of Bucharest, Bucharest, Romania
1996-1997 *Assistant Professor of Biological Physics*, University of Bucharest, Bucharest, Romania
1997-1998 *Visiting Research Associate,* University of Missouri-Kansas City, Kansas City, Missouri
1999-2004 *Postdoctoral Research Associate,* Texas A&M University, College Station, Texas
2004-2010 *Assistant Professor of Physics,* Syracuse University, Syracuse, New York
2010-2016 *Associate Professor of Physics*, Syracuse University, Syracuse, New York
2015- *Adjunct Professor of Chemistry*, Syracuse University, Syracuse, New York
2016- *Professor of Physics*, Syracuse University, Syracuse, New York

B2. Other Experience and Professional Memberships

1993-1994 *Graduate Research Fellowship,* University of Amsterdam, Amsterdam, The Netherlands
1997 *Research Fellow,* Tempus Program, CEN Saclay, Paris, France
1998- *Member,* American Biophysical Society
1998-2003 *Associate Member,* Abdus Salam ICTP, Trieste, Italy
2002-2003 *Visiting Assistant Professor,* Delft University of Technology, Delft, The Netherlands
2004- *Member,* Structural Biology, Biochemistry, and Biophysics Program (SB3) of Syracuse University
2004 *Panel member*, *Designing Nanostructures Pre-Conference*, National Academies Keck *Futures Initiative*, Washington, D.C., USA
2004 *Panel adviser*, *The National Academies/Keck Future Initiatives*: "*Designing Nanostructures at the Interface between Biomedical and Physical Systems*," Irvine, California, USA
2005 *Member,* American Physical Society, International Association of Nanotechnology
2007- *Member,* Syracuse Biomaterials Institute (SBI), Syracuse, New York

2007 *Panel member and adviser*, The NSF Workshop on Biosensing and Bioactuation, "*The NSF Initiative in Biosensing and Bioactuation*," College Park, Maryland, USA

2008- *Associate Fellow*, Institute for Complex Adaptive Matter (ICAM)

2008-2014 *Regular Panel Reviewer*, National Science Foundation, Arlington, Virginia, USA

2010- *Member*, SUNY Upstate Cancer Research Institute (CRI), Syracuse, New York

2011- *Member,* Forensic and National Security Science Institute (FNSSI), Syracuse University, Syracuse, New York, USA

2011-2016 *Member*, The IGERT Graduate Program, "Soft Interfaces - Bridging the Divide in Graduate Education (iBriD)**,** Syracuse, New York, USA

2011 *Reviewer*, the Netherlands Organization for Scientific Research (NWO), Amsterdam, The Netherlands

2011- *Panel member*, The NSF Workshop at the University of Wisconsin: "*Open Forum for Innovation in Two-Photon Microspectroscopy*," Milwaukee, Wisconsin, USA

2012-2014 *Reviewer*, the Belgian Research Council, Brussels, Belgium, February 2012

2012- *Panel member & adviser*, The NSF Biomaterials Workshop – *Important Areas for Future Investment*, The NSF Initiative in Biomaterials, Arlington, Virginia, USA

2012- *Director*, Structural Biology, Biochemistry, and Biophysics Program (SB3), Syracuse University

2014- *Associate Editor*, *Current Bionanotechnology*

2015- *Panel Reviewer*, Biomaterials and Biointerfaces (BMBI) Study Section, National Institutes of Health

2015-2016 *Reviewer*, NIH Transformative Research Program, National Institutes of Health

2016 *Panel member and adviser*, The NSF Biomaterials Workshop – "*Important Areas for Future Investment in Biomaterials*" by the NSF-DMR-MIP Program, Arlington, Virginia, USA

B3. Honors and Awards

1997-2002 *Associate Research Fellowship*, Abdus Salam ICTP, Trieste, Italy

1997 *Research Fellowship*, TEMPUS Program of the European Community, Higher Education Commission, CEA Paris, France

1998 *Recipient*, Welcome Trust Award for International Postdoctoral Fellows, United Kingdom

2012 *Faculty Mentor*, Beckman Scholars Program, Syracuse University

C. Contribution to Science

C1. Design and development of single-molecule biosensors

The central goal of my research program is the redesign and adaptation of β-barrel transmembrane protein pores for the single-molecule studies and creation of stochastic sensing elements. We have successfully redesigned transmembrane protein pores for the development of biomolecular sensors, which were utilized at high temporal and spatial resolution and under harsh conditions of experimentation (e.g., very acidic pH). We have persistently used the α-hemolysin (αHL) protein, a heptameric β-barrel pore-forming complex of *Staphylococcus aureus*. The primary driving force of these studies represented its unusual mechanical and thermodynamic stability, enabling both chemical and genetic engineering of affinity groups at strategic locations within the pore lumen and without impairing its functional features. Thus, extensive membrane protein design studies using αHL transformed the area of single-molecule biophysics by revealing opportunities for discovering protein-based sensing elements for a variety of small-molecule chemicals and biopolymers, such as polysaccharides, polypeptides, folded proteins, and nucleic acids. More recently, we were able to convert ferric hydroxamate ferric uptake component A (FhuA) from a non-conductive outer membrane protein to a large-conductance, monomeric transmembrane protein pore, which can be readily used in a broad range of analytical applications.

1. M.M. Mohammad, R. Iyer, K.R. Howard, M.P. McPike, P.N. Borer and **L. Movileanu**, 2012, Engineering a Rigid Protein Tunnel for Biomolecular Detection, *J. Am. Chem. Soc.* **134(22)**, 9521-9531. PMCID: PMC3415594

2. **L. Movileanu**, 2009, Interrogating single proteins through nanopores: challenges and opportunities, *Trends Biotechnol.* **27(6)**, 333-341.
3. M.M. Mohammad, S. Prakash, A. Matouschek and **L. Movileanu**, 2008, Controlling a single protein in a nanopore through electrostatic traps, *J. Am. Chem. Soc.* **130(12)**, 4081-4088.
4. A.J. Wolfe, M.M. Mohammad, S. Cheley, H. Bayley and **L. Movileanu**, 2007, Catalyzing the translocation of polypeptides through attractive interactions, *J. Am. Chem. Soc*. **129(45)**, 14034-14041.

C2. Molecular biomedical diagnostics using solid-state nanopores

We have expanded our knowledge in the area of molecular biomedical diagnostics by designing and developing sensing elements with solid-state nanopores. We were able to fabricate such sensors using silicon-nitride membranes and focused electron beams of a high-accelerating voltage transmission electron microscope (TEM). Our primary contribution to this area of research was the first single-molecule determination of spontaneous protein adsorption on an inorganic surface. Moreover, we were able to extend these explorations in the area of biomarker discovery and analysis. Thus, this methodology shows promise for molecular biomedical diagnostics of various diseases at stages much earlier than currently possible and without use of highly qualified personnel, expensive reagents, as well as sophisticated equipment.

1. D.J. Niedzwiecki, R. Iyer, P.N. Borer and **L. Movileanu**, 2013, Sampling a Biomarker of the Human Immunodeficiency Virus across a Synthetic Nanopore, *ACS Nano* **7(4)**, 3341-3350. PMCID: PMC3634884
2. D.J. Niedzwiecki and **L. Movileanu**, 2011, Monitoring protein adsorption with solid-state nanopores, *J. Vis. Exp.* **58**, e3560, DOI: 10.3791/3560. PMCID: PMC3353539
3. D.J. Niedzwiecki, J. Grazul and **L. Movileanu**, 2010, Single-molecule observation of protein adsorption onto an inorganic surface, *J. Am. Chem. Soc.* **132(31)**, 10816-10822. PMCID: PMC2917251

C3. Structural and functional studies of the outer membrane carboxylate channels in *Pseudomonas aeruginosa*

In collaboration with Dr. Bert van den Berg (now at The University of Newcastle upon Tyne, UK), we have devoted extensive biochemical, biophysical, and functional studies on the outer membrane carboxylate proteins (Occ) in *P. aeruginosa*. The primary function of the Occ proteins is to mediate the uptake of small nutrients, in the form of polar and nonpolar substrates, for the growth and vitality of the cell. This collaboration, through an R01 grant, generated ~9 joint publications between both research teams. In brief, we employed high-resolution, single-channel electrical recordings to obtain a comprehensive biophysical analysis of thirteen members of the Occ family in *P. aeruginosa*. This work was instrumental for the elucidation of specificity and selectivity of substrate uptake through individual Occ proteins.

1. E. Eren, J. Parkin, A. Adelanwa, B.R. Cheneke, **L. Movileanu**, S. Khalid and B. van den Berg, 2013, Towards understanding the outer membrane uptake of small molecules by *Pseudomonas aeruginosa*, *J. Biol. Chem*. **288(17)**, 12042-12053. PMCID: PMC3636890
2. B.R. Cheneke, M. Indic, B. van den Berg and **L. Movileanu**, 2012, An Outer Membrane Protein undergoes Enthalpy- and Entropy-driven Transitions, *Biochemistry* **51(26)**, 5348-5358. PMCID: PMC3448022
3. J. Liu, E. Eren, J. Vijayaraghavan, B.R. Cheneke, M. Indic, B. van den Berg and **L. Movileanu**, 2012, OccK Channels from *Pseudomonas aeruginosa* Exhibit Diverse Single-channel Electrical Signatures, but Conserved Anion Selectivity, *Biochemistry* **51(11)**, 2319-2330. PMCID: PMC3311111
4. S. Biswas, M.M. Mohammad, **L. Movileanu** and B. van den Berg, 2008, Crystal structure of outer membrane protein OpdK from *Pseudomonas aeruginosa*, *Structure* **16(7)**, 1027-1035.

C4. Membrane protein design, folding and stability

Extensive biochemical and biophysical studies in my laboratory involved ample genetic engineering of a diverse range of α-helical and β-barrel protein pores, resulting in new bionanostructures with novel functional

and electrophysiological features. For example, we were able to produce a dramatic modification of the lumen of a β-barrel protein pore by implementing 25 acidic charge neutralizations of acidic residues. Such a drastic change of the surface charge of the inner surface of a transmembrane protein pore without altering its open-conductance state demonstrates the robustness, versatility and tractability of β-barrel structures. These unique opportunities helped us to obtain informative data on spontaneous current gating in β-barrel pores when large deletions of extracellular loops were conducted thorough targeted protein engineering.

1. A.J. Wolfe, M.M. Mohammad, A.K. Thakur, and **L. Movileanu**, 2016, Global Redesign of a Native β-barrel Scaffold, *Biochim. Biophys. Acta Biomembranes* **1858(1)**, 19-29. PMCID: NIHMS733294
2. S. Couoh-Cardel, Y.C. Hsueh, S. Wilkens, and **L. Movileanu**, 2016, Yeast V-ATPase Proteolipid Ring Acts as a Large-conductance Transmembrane Protein Pore, *Sci. Rep.* **6**, 24774. PMCID: PMC4838861
3. J.F. Gugel and **L. Movileanu**, 2015, Staphylococcal β-barrel Pore-forming Toxins: Mushrooms That Breach the Greasy Barrier, *Springer Series in Biophysics*, Martinac, B. (Series Ed.), Vol. 18, *Electrophysiology of Unconventional Channels and Pores,* Chapter, 10, Delcour, A.H. (Ed.), Springer, New York, pp. 241-266.
4. B.R. Cheneke, B. van den Berg, and **L. Movileanu**, 2015, Quasithermodynamic Contributions to the Fluctuations of a Protein Nanopore, *ACS Chem. Biol.* **10(3)**, 784-794. **PMCID: PMC**4372101

C5. Voltage gating in β-barrel proteins

My other long-standing research interest is to obtain a better quantitative understanding of the voltage gating process in β-barrel membrane proteins. This is because the molecular basis by which β-barrel proteins switch among various well-defined and functionally distinct sub-states remains elusive. We extensively examined voltage gating in a number of outer membrane proteins and pore-forming toxins. Our contributions in this area included a semi-quantitative analysis of the kinetics and thermodynamics of these ubiquitous processes at single-molecule resolution.

1. B.R. Cheneke, B. van den Berg and **L. Movileanu**, 2011, Analysis of gating transitions among the three major open states of the OpdK channel, *Biochemistry* **50(22)**, 4987-4997. PMCID: PMC3107985
2. M.M. Mohammad, K.R. Howard and **L. Movileanu**, 2011, Redesign of a plugged beta-barrel membrane protein, *J. Biol. Chem.* **286(10)**, 8000-8013. PMCID: PMC3048687
3. M.M. Mohammad and L. Movileanu, 2010, Impact of distant charge reversals within a robust β-barrel protein pore, *J. Phys. Chem. B* 114(26), 8750-8759. PMCID: PMC2907733
4. S. Biswas, M.M. Mohammad, D.R. Patel, **L. Movileanu** and B. van den Berg, 2007, Structural insight into OprD substrate specificity, *Nature Struct. Mol. Biol.* **14(11)**, 1108-1109.

A complete List of Published Work can be found in NCBI MyBibliography:

http://www.ncbi.nlm.nih.gov/sites/myncbi/1TmmV3-o4fyQO/bibliography/40279609/public/?sort=date&direction=descending