

## *Curriculum Vitae*

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### **Research interests**

- Structural organization of cellular membranes.
- Biogenesis and evolution of membrane proteins.
- Membrane protein production in heterologous hosts.
- Identification of novel membrane proteins in model and uncharacterized microbes.
- Engineering microbial cell factories for the production of high-value compounds from renewable biomass.

### **Current position**

2019- Project Scientist at the Department of Chemical Engineering, University of California, Santa Barbara, USA.

### **Academic degrees and previous positions**

2017-18 Associate Specialist at the Department of Chemical Engineering, University of California, Santa Barbara, USA.

2014-16 Visiting scholar (Villum Young Investigator Fellow) at the Department of Chemical Engineering, University of California, Santa Barbara, USA. Mentor: Dr. Michelle O'Malley

2012-14 Postdoc (Villum Young Investigator Fellow) at the Novo Nordisk Foundation Center for Biosustainability, Technical University of Denmark. Mentor: Dr. Morten Nørholm

2012 **PhD in Biochemistry.** Thesis: *Dual-topology membrane proteins in Escherichia coli*, ISBN 978-91-7447-351-3. Stockholm Center for Biomembrane Research, Department of Biochemistry and Biophysics, Stockholm University, Sweden. Advisor: Prof. Gunnar von Heijne

2005 **MSc in Molecular biology.** Department of Botany, Stockholm University, Sweden. Advisor: Prof. Birgitta Bergman

### **Scientific publications**

*Number of publications:* 23. *Number of citations:* 745. *h-index:* 10 (Google Scholar, 1 July 2019)  
<https://scholar.google.com/citations?user=vKILbPQAAAAJ&hl=en>

*Impact of selected papers:* Rapp, Granseth et al. 2006; Rapp, Seppälä et al. 2007; and Seppälä et al. 2010 describe how membrane proteins acquire their overall orientation in bacterial membranes. To date, these groundbreaking papers have been cited >300 times. Wendel et al. 2016 describes a

tool for assessing surface-displayed enzymes in bacteria; Seppälä et al. 2016 describes the first effort to map the membrane proteome of biomass-degrading anaerobic fungi and Seppälä et al. 2019 describes the successful heterologous production of solvent transporters from anaerobic fungi in model yeast.

- 2019 Swift CL, Brown JL, Seppälä S, O'Malley MA. Co-cultivation of the anaerobic fungus *Anaeromyces robustus* with *Methanobacterium bryantii* enhances transcription of carbohydrate active enzymes. *Journal of Industrial Microbiology and Biotechnology*. Available online 14 May 2019: <https://link.springer.com/article/10.1007/s10295-019-02188-0>
- 2019 Seppälä S\*, Yoo JI\*, Yur D, O'Malley MA. Heterologous transporters from anaerobic fungi bolster fluoride tolerance in *Saccharomyces cerevisiae*. *Metabolic Engineering Communications*. Available online 11 April 2019. doi: 10.1016/j.mec.2019.e00091
- 2019 Podolsky IA\*, Seppälä S\*, Lankiewicz TS, Brown JL, Swift CL, O'Malley MA. Harnessing nature's anaerobes for biotechnology and bioprocessing. *Annual Review of Chemical and Biomolecular Engineering* 10:6.1-6.24 (2019). doi: 10.1146/annurev-chembioeng-060718-030340
- 2019 Wilken S, Swift CL, Podolsky IA, Lankiewicz TS, Seppälä S, O'Malley MA. Linking "omics" to function unlocks the biotech potential of non-model fungi. *Current Opinion in Systems Biology*. 14:9-17 (2019). doi: 10.1016/j.coisb.2019.02.001
- 2017 Seppälä S\*, Wilken S\*, Knop D, Solomon KV, O'Malley MA: The importance of sourcing enzymes from non-conventional fungi for metabolic engineering and biomass breakdown. *Metabolic Engineering* 44:45-59 (2017) PMID: 28943461
- 2017 Gilmore SP, Henske JK, Sexton JA, Solomon KV, Seppälä S, Yoo JI, Huyett LM, Pressman A, Cogan JZ, Kivenson V, Peng X, Tan Y, Valentine DL, O'Malley MA: Genomic analysis of methanogenic archaea reveals a shift towards energy conservation. *BMC Genomics* 18(1): 639 (2017) PMID: 28826405
- 2017 Vázquez-Albacete D, Cavaleiro AM, Christensen U, Seppälä S, Møller BL, Nørholm MHH: An expression tag toolbox for microbial production of medicinal cytochromes P450. *Biotechnology and Bioengineering* 114(4):751-760 (2017) PMID: 27748524
- 2017 Christensen U, Vázquez-Albacete D, Søgaard KM, Hobel T, Nielsen MT, Harrison SJ, Hansen AH, Møller BL, Seppälä S, Nørholm MHH: De-bugging and maximizing plant cytochrome P450 production in *Escherichia coli* with C-terminal GFP-fusions. *Applied Microbiology and Biotechnology* 101(10):4103-4113 (2017) PMID: 28204885
- 2016 Seppälä S, Solomon KV, Gilmore SP, Henske JK, O'Malley MA: Mapping the membrane proteome of anaerobic gut fungi identifies a wealth of carbohydrate binding proteins and transporters. *Microbial Cell Factories* 15(1):212 (2016) PMID: 27998268
- 2016 Wendel S, Fischer EC, Martínez V, Seppälä S, Nørholm MHH: A nanobody:GFP bacterial platform that enables functional enzyme display and easy quantification of display capacity. *Microbial Cell Factories* 15(1):71 (2016) PMID: 27142225
- 2015 Cavaleiro AM, Kim SH, Seppälä S, Nielsen MT, Nørholm MHH: Accurate DNA assembly and genome engineering with optimized uracil excision cloning. *ACS Synthetic Biology* 4(9): 1042-1046 (2015) PMID: 26263045
- 2015 Cavaleiro AM, Nielsen MT, Seppälä S, Nørholm MHH: Uracil excision for assembly of complex pathways. *Hydrocarbon and Lipid Microbiology Protocols, Springer Protocols Handbook*, pp 27-37. Humana Press (2015)

- 2014 Nielsen MT, Madsen KM, Seppälä S, Christensen U, Harrison SJ, Møller BL, Nørholm MHH: Assembly of highly standardized gene fragments for high level production of porphyrins in *E. coli*. *ACS Synthetic Biology* 4(3): 274-282 (2014) PMID: 24905856
- 2014 Lloris-Garcerá P, Seppälä S, Slusky JSG, Rapp M, von Heijne G: Why have Small Multidrug Resistance proteins not evolved into fused, internally duplicated structures? *Journal of Molecular Biology* 426(11): 2246-2254 (2014) PMID: 24690367
- 2013 Lloris-Garcerá P, Slusky JSG, Seppälä S, Prieß M, Schäfer LV, von Heijne G: *In vivo* Trp-scanning of the small multidrug resistance protein EmrE confirms 3D structure models. *Journal of Molecular Biology* 425(22): 4642-4651 (2013) PMID: 23920359
- 2012 Lloris-Garcerá P, Bianchi F, Slusky JSG, Seppälä S, Daley DO, von Heijne G: Antiparallel dimers of the small multidrug-resistance protein EmrE are more stable than parallel dimers. *Journal of Biological Chemistry* 287(31): 26052-26059 (2012) PMID: 22700980
- 2010 Seppälä S, Slusky JS, Lloris-Garcerá P, Rapp M, von Heijne G: Control of membrane protein topology by a single C-terminal residue. *Science* 328(5986): 1698-1700 (2010) PMID: 20508091
- 2008 Cassel M, Seppälä S, von Heijne G: Confronting fusion-protein based membrane protein topology mapping with reality: the *Escherichia coli* ClcA H+/Cl- exchange transporter. *Journal of Molecular Biology* 381(4): 860-866 (2008) PMID: 18590742
- 2008 Bauer K, Díez B, Lugomela C, Seppälä S, Borg AJ, Bergman B: Variability in benthic diazotrophy and cyanobacterial diversity in a tropical intertidal lagoon. *FEMS Microbiology Ecology* 63(2): 205-221 (2008) PMID: 18199084
- 2007 Rapp M\*, Seppälä S\*, Granseth E, von Heijne G: Emulating membrane protein evolution by rational design. *Science* 315(5816): 1281-1284 (2007) PMID: 17255477
- 2007 Xie K, Hessa T, Seppälä S, Rapp M, von Heijne G, Dalbey R: Features of transmembrane segments that promote the lateral release from the translocase into the lipid phase. *Biochemistry* 46(51): 15153-15161 (2007) PMID: 18052199
- 2007 Granseth E, Seppälä S, Rapp M, Daley DO, von Heijne G: Membrane protein structural biology - how far can the bugs take us? *Molecular Membrane Biology* 24(5-6): 329-332 (2007) PMID: 17710636
- 2006 Rapp M\*, Granseth E\*, Seppälä S, von Heijne G: Identification and evolution of dual-topology membrane proteins. *Nature Structural and Molecular Biology* 13(2): 112-116 (2006) PMID: 16429150

### Scholarships and awards

- 2015 EMSL Community Science User Program, "Characterizing the Cellular envelope and secreted compounds of anaerobic gut fungi". Allocation of spectroscopy and microscopy resources (PI: Michelle O'Malley) (Estimated value ~100,000 USD)
- 2012 VILLUM Foundation's Young Investigator Programme VKR023128 (3,000,000 DKK)
- 2012 Stockholm University Association's (Högskoleföreningen) award for the most distinguished PhD thesis at the Faculty of Science
- 2010 Donationsstipendium (stipend), Jan-Artur Ekströms minnesstiftelse
- 2007 FEBS Short-term fellowship (LMB, Cambridge, UK)
- 2007 FEBS Youth Travel Fund
- 2006 Liljevalch J:ors resestipendium (travel stipend)
- 2005 SIDA Minor Field Study grant (Dar es Salaam/Zanzibar, Tanzania)

## Professional memberships

- AAAS, American Association for the Advancement of Science (#41597892)
- ACS, American Chemical Society (#31225938)
- Naturvetarna (#124483)

## Conferences

- 2019 American Chemical Society National Meeting & Expo. Orlando, FL, USA (speaker)
- 2018 Engineering Biology Research Consortium, Spring 2018 retreat. Seattle, WA, USA (speaker)
- 2017 Engineering Biology Research Consortium, Fall 2017 retreat. Atlanta, GA, USA (poster presenter)
- 2017 Biochemical and Molecular Engineering XX. Newport Beach, CA, USA (poster presenter)
- 2017 253rd American Chemical Society National Meeting. San Francisco, CA, USA (speaker)
- 2016 FASEB meeting: Molecular Biophysics of Membranes. Snowmass Village, CO, USA (poster presenter)
- 2016 Biophysical Society, 60th Annual Meeting. Los Angeles, CA, USA (poster presenter)
- 2016 5th UCSB-Chalmers Workshop on Materials. Santa Barbara, CA, USA (speaker)
- 2014 Synbio Conference: Synthetic Biology meets Organic Synthesis. Berkeley, CA, USA (poster presenter)
- 2013 Benzon Symposium No.59: Membrane Proteins - Structure, Function and Dynamics. Copenhagen, Denmark (poster presenter)
- 2013 Biobricks Foundation SB6.0: the 6th International Meeting on Synthetic Biology. London, UK (participant)
- 2012 11th International Symposium on Cytochrome P450 Biodiversity and Biotechnology. Torino, Italy (poster presenter)
- 2012 Metabolic Engineering IX. Biarritz, France (poster presenter)
- 2011 IX European Symposium of the Protein Society: Wonders and Disasters of the Protein World. Stockholm, Sweden (participant)
- 2009 Gordon Research Conference: Protons and Membrane Reactions. Ventura, CA, USA (speaker)
- 2008 NOW-CW Meeting: Lipids and Biomembranes. Lunteren, Netherlands (keynote speaker)
- 2007 NVII European Symposium of the Protein Society: From Proteins to Proteome. Stockholm, Sweden (participant)
- 2007 EMBO Workshop: New Methods in Membrane Protein Biology. Stockholm, Sweden (participant)
- 2006 MRC Dunn/DBB joint meeting. Cambridge, UK (speaker)
- 2006 EMBO Workshop: Cell Membrane Organization and Dynamics. Bilbao, Spain (participant)
- 2006 35th annual meeting of the Danish Society for Biochemistry and Molecular Biology: Membrane Proteins - Structure and Function. Fyn, Denmark (participant)

## Teaching and selected outreach activities

- 2019 Mentoring, 1 undergraduate student in the laboratory of Prof. Michelle O'Malley at University of California, Santa Barbara.
- 2018 Mentoring, 1 undergraduate student in the laboratory of Prof. Michelle O'Malley at University of California, Santa Barbara.
- 2018 Invited speaker at *Breaching biotech UCSB* at University of California, Santa Barbara: 'Building a sustainable future.'
- 2018 Invited lecturer at the undergraduate course *Chemical Engineering 170: Molecular and Cell Biology for Engineers* at University of California, Santa Barbara: 'Genetic engineering - ethical considerations.'
- 2018 Invited lecturer at the undergraduate course *Chemical Engineering 170: Molecular and Cell Biology for Engineers* at University of California, Santa Barbara: 'Protein trafficking and quality control.'
- 2018 Outreach activity at Santa Barbara Zoo: Conservation Awareness Day (with the laboratory of Prof. Michelle O'Malley at University of California, Santa Barbara).
- 2018 Outreach activity at Peabody Charter School in Santa Barbara: teaching 2nd graders about microbes and biotechnology ('How come cows can eat grass?')
- 2017 Mentoring, 2 undergraduate students in the laboratory of Dr. Michelle O'Malley at University of California, Santa Barbara.
- 2016 Invited lecturer at the undergraduate course *Chemical Engineering 170: Molecular and Cell Biology for Engineers* at University of California, Santa Barbara: 'Designing Bio-products from Scratch.'
- 2016 Invited lecturer at the undergraduate course *Chemical Engineering 171E: Biochemical Engineering* at University of California, Santa Barbara: 'Membrane proteins for microbial engineering.'
- 2015-16 Outreach activities at Santa Barbara Zoo: teaching children about microorganisms (with the laboratory of Dr. Michelle O'Malley at University of California, Santa Barbara).
- 2014-16 Mentoring, 2 undergraduate students in the laboratory of Dr. Michelle O'Malley at University of California, Santa Barbara.
- 2013-16 Co-advisor, 1 PhD student (Sofie Wendel) in the laboratory of Dr. Morten Nørholm at Novo Nordisk Foundation Center for Biosustainability, Technical University of Denmark.
- 2013 Invited lecturer at the undergraduate course *Biochemistry 2* at University of Copenhagen: 'Optimizing the production of plant natural compounds in microorganisms.'
- 2013 Invited speaker at *Berzeliusdagarna*, an annual conference for 350 high school students, organized by the Swedish Chemical Society (Svenska kemistsamfundet): 'Membranproteiner – hur celler ser på världen.'
- 2007-10 Teaching practicals at the undergraduate course *Basic course in Biochemistry* (KB3002, 15ECTS) at Stockholm University.
- 2008 Public lecture at Stockholm University: 'Livets tunna hinna - cellens feta omslag. Hur celler kommunicerar med sin omvärld?'
- 2008 Seminar 'Proteins: an introduction', TA Instruments, Stockholm.
- 2008 Mentoring, 2 undergraduate students in the laboratory of Prof. Gunnar von Heijne at Stockholm University.
- 2008 Mentoring, 2 Master of Science diploma students in the laboratory of Prof. Gunnar von Heijne at Stockholm University.
- 2007 Public lecture at Stockholm University: 'Cellmembran – livets barriärer.'

2006      Mentoring, 6 high school students within Stockholm University's Research-school for high school students.

**Selected publicity**

- Bioteknikens dreamteam ("The dream team of biotech", newspaper article, in Swedish). (*IVA Aktuellt 2, 2013*)
- Framtidens cellfabriker ("Cellfactories for the future", newspaper article, in Swedish). (*Vetenskapsrådets webbtidning Curie, 14 May 2013*)

**Professional development and extracurricular activities**

- Occupational Health and Safety Representative at Technical University of Denmark (*2013*)
- Certified PADI Rescue Diver
- Secretary, Santa Barbara chapter of Swedish Women's Educational Association International Organization (SWEA)