

# Jeppe Kari

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## RESEARCH INTERESTS

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My field of research is biophysical chemistry with an expertise in biocatalysis. I am particularly interested in understanding the kinetics and thermodynamic of enzymes that work at the solid-liquid interface (interfacial enzymes). My vision is to establish the field of interfacial enzymology (heterogeneous biocatalysis) and contribute to the bridging of inorganic heterogeneous catalysis and heterogeneous biocatalysis by finding common theoretical concepts. Further, I wish to use empirical scaling relation and experimental descriptors to predict enzyme activity *in silico* and design better enzymes using theory- and computational-guided design. In my research I try to develop experimental assays and techniques to experimentally characterize interfacial enzyme and extract experimental descriptors to understand trends. Kinetic modeling plays a crucial role in my research as it acts as the link between structure and function.

## EMPLOYMENTS

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2019 - now Postdoc at the Technical University of Denmark in the Dept. of Biotech. and Biomedicine  
2018 - now Assistant professor, Dept. of Science and Environment, Roskilde University  
*I have been granted 3 years leave of absence to focus on research (Postdoc at DTU) that would help to establish the field of heterogeneous catalysis. This has resulted in a newly published article in Nature Communication (see list of publications, P1).*  
2016-2017 Postdoc, Department of Science and Environment, Roskilde University  
2013-2016 Ph.D. fellow in biochemistry, Department of Science and Environment, Roskilde University

## EDUCATION AND DEGREES

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2017 Ph.D., Interfacial Enzymology, Department of Science and Environment, RUC  
2013 MSc, Mol. biology and Chemistry, Department of Science and Environment, RUC  
2009 BSc, Mol. biology and Chemistry, Department of Science and Environment, RUC

## PATENTS

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2014 Westh, P; Kari, J; Olsen, J; Borch, K; Jensen, K; Krogh, KBRM (May 1, 2014) PCT International Patent Appl. WO/2014/064115  
2014 Borch, K; Jensen, K; Krogh, KBRM; McBrayer, B; Westh, P; Kari, J; Olsen, J; Sørensen, T; Windahl, M; Xu, H (September 12, 2014) PCT International Patent Appl. WO/2014/138672

## PUBLICATIONS

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Web of science (since 2014)

- **Publications: 24 Citations : 304 (410 Goggle Scholar) h-index: 11 (12 Goggle Scholar)**

Selected publications since 2014 (full list at page 4-5)

2014 **Kari J.** et al. , *Journal of Biological Chemistry*, 289 (47), 2014  
Kinetics of cellobiohydrolase (Cel7A) variants with lowered substrate affinity  
2015 F. Colussi et al., *Journal of Biological Chemistry*, 290 (4), 2015  
Probing substrate interactions in the active tunnel of a catalytically deficient cellobiohydrolase (Cel7)  
2016 **Kari J.** et al., *Biochemistry* 56 (1), 2016  
Anomeric Selectivity and Product Profile of a Processive Cellulase  
2017 **Kari J.** et al., *ACS Catalysis* 7 (7), 2017  
An Inverse Michaelis–Menten Approach for Interfacial Enzyme Kinetics  
2018 **Kari J.** et al., *ACS Catalysis* 8 (12), 2018  
Sabatier Principle for Interfacial (Heterogeneous) Enzyme Catalysis  
2019 **Kari J.** et al., *Analytical Biochemistry* 586, 2019  
A practical approach to steady-state kinetic analysis of cellulases acting on their natural insoluble substrate  
2020 **Kari J.** et al., *Biochemical Journal* 477 (10), 2020  
A steady-state approach for inhibition of heterogeneous enzyme reactions  
2021 **Kari J.** et al., *Nature Communication* 12, 3847, 2021  
Physical constraints and functional plasticity of cellulases

## TEACHING AND PAST JOB EXPERIENCE

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2021	Quantitative analysis and modeling in protein science (Graduate course) Asst. teacher, DTU
2021	Cross Institutional Molecular Biophysics (PhD course), Assistant teacher, DTU
2019 - now	Experimental Enzyme Technology (Graduate course), Teacher, DTU
2017/18	Methods in biophysical chemistry (Graduate course), Teacher, Roskilde University
2018	Frontiers in chemistry (Graduate course), Teacher, Roskilde University
2015	Chemistry of ions (Undergraduate course), Assistant teacher, Roskilde University
2015	Organic chemistry (Undergraduate course), Assistant teacher, Roskilde University
2014	Biological chemistry (Undergraduate course), Assistant teacher, Roskilde University
2014	Laboratory course (Undergraduate course), Assistant teacher, Roskilde University
2013	General Chemistry (Undergraduate course), Assistant teacher, Roskilde University
2013	Microcalorimetry (Graduate course), Assistant teacher, Roskilde University
2010-2011	General Chemistry (High school), Teacher, VUC, Copenhagen
2009-2011	General Calculus (High school), Teacher, Niels Brock Business College, Copenhagen

### Supervision PhD (co-supervisor) : 2

Kay Schaller (expected 2021, DTU), Gustavo Avelar Molina (expected 2021, DTU)

### Master theses: 3

Mario Paolo Penta (expected 2021, DTU), Maria Nørr (2018, RUC), Jeannie Rasmussen (2018, RUC)

### Bachelor theses: 9

Zara Alam (2015, RUC), Thomas Andersen (2015, RUC), Kamila Kamuda (2015, RUC), Josh Shailes (2015, RUC), Nanna Rolsted Sørensen (2015, RUC), Emma Sofie Ahrenkiel Andersen (2018, RUC), Lea Marie Juul Christensen (2018, RUC), Mikala Meling Tang (2018, RUC) and Matilde Zinck Leth-Espensen (2018, RUC)

### Graduate project: 2

Iro-Efthymia Pappa (Special course 2021, DTU), Morten Bjørn Nielsen (Special course 2020, DTU)

**Undergraduate project:** 4 undergraduate projects (30 ETCS) at Roskilde University from 2013-2017

### Certificate

Certificate of University Teaching and Learning, CUTL (Expected 2021, see attachment)  
Certified to teach English-medium courses (see see attachment)

## CONFERENCES, WORKSHOPS AND SEMINARS

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2013	<b>4th Annual Workshop on Enzymatic Hydrolysis of Insoluble</b> Organizer of the 2-day workshop at Søminestationen, Holdbæk
2013	<b>Novozymes A/S,</b> Oral presentation, Novozymes A/S, Bagsværd <i>Product inhibition of cellobiohydrolases is a two-edged sword.</i>
2015	<b>Gordon Research Conference</b> Poster at the Gordon Research Conference on "Cellulosomes, cellulases and other carbohydrate modifying enzymes", New Hampshire <i>Odd and even product ratio as a measure of processivity for cellulase</i>
2017	<b>Stanford University</b> Poster at the SUNCAT Summer Institute 2017 entitled "Fundamentals and Applications of Heterogeneous Catalysis", California <i>Application of the Sabatier Principle in Heterogeneous Biocatalysis</i>
2017	<b>Roskilde University</b> Oral presentation, Department of Science and Environment, Roskilde University <i>Inverse enzyme kinetics – same same but different</i>
2018	<b>Kaj Ulrik Linderstrøm-Lang Symposium</b> Poster at the Kaj Ulrik Linderstrøm-Lang Symposium entitled "Protein order and disorder", Copenhagen University

- 2018 *Application of the Sabatier principle in heterogeneous biocatalysis*  
**Technical University of Denmark**  
 Oral presentation, Dept. of Biotechnology and Biomedicine
- 2019 *Exploring the functional role of the product binding site of Cellobiohydrolase Cel7A*  
**19th protein DTU workshop**  
 Poster at the 19th protein DTU workshop, Dept. of Biotechnology and Biomedicine
- 2019 *Linear free energy relationship for cellulolytic enzymes*  
**Technical University of Denmark,**  
 Oral presentation, Dept. of Biotechnology and Biomedicine
- 2020 *A Steady-State Approach for inhibition of Heterogeneous Enzyme reactions*  
**Technical University of Denmark,**  
 Oral presentation, Dept. of Biotechnology and Biomedicine
- 2020 *Bridging the gap between heterogeneous- and biocatalysis*  
**Roskilde University**  
 Invited talk Department of Science and Environment, Roskilde University
- 2020 *Linear scaling relationships in heterogeneous (bio)catalysis*  
**Technical University of Denmark,**  
 Oral presentation, Dept. of Biotechnology and Biomedicine
- 2020 *Protein-ligand binding heterogeneity*  
**Novozymes A/S,**  
 Oral presentation, Novozymes A/S, Lyngby
- 2020 *The simplifying power of scaling relationships - A bird's-eye view on cellulase activity*

## POPULAR SCIENCE AND MEDIA

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- 2014 Videnskab.dk, 2014, Miljøvenlig 'biobenzin' rykker nærmere med nyt, dansk enzym
- 2014 Biofuels Digest, 2014, Novozymes and Roskilde University discover super-producing enzyme
- 2015 Dansk Kemi (11), 2015, Rationelt Design af Enzymer
- 2015 Jyllands Posten, 2015, Dansk opfindelse baner vej for miljøvenligt brændstof

## POSITION OF TRUST

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- 2010-2012 Union representative, Experimentarium Science Museum, Copenhagen
- 2009-2011 Study board of Chemistry, Roskilde University

## LIST OF PUBLICATIONS

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- P1 Kari, J., Molina, G., Schaller, K., Schiano-di-Cola, C., Christensen, S. J., Badino, S., Sørensen, T.H., Røjel, N., Keller, M., Sørensen, N., Kołaczowski, B., Olsen, J.P., Krogh, K.B.R.M., Jensen, K., Cavaleiro, A.M., Peters, G.H.J., Spodsberg, N., Borch, K., Westh, P. Physical constraints and functional plasticity of cellulases. *Nat Commun* 12, 3847 (2021).
- P2 Schaller, K.S., Kari, J., Molina, G.A., Tidemand, K.D., Borch, K., Peters, G.H.J., Westh, P., Computing Cellulase Kinetics with a Two-Domain Linear Interaction Energy Approach (2021) *ACS Omega*, 6 (2), pp. 1547-1555.
- P3 Keller, M.B., Badino, S.F., Røjel, N., Sørensen, T.H., Kari, J., McBrayer, B., Borch, K., Blossom, B.M., Westh, P., A comparative biochemical investigation of the impeding effect of C1-oxidizing LPMOs on cellobiohydrolases, (2021) *Journal of Biological Chemistry*, 296, 100504, .
- P4 Røjel, N., Kari, J., Sørensen, T.H., Borch, K., Westh, P., pH profiles of cellulases depend on the substrate and architecture of the binding region, (2020) *Biotechnology and Bioengineering*, 117 (2), pp. 382-391.
- P5 Kari, J., Schiano-Di-Cola, C., Hansen, S.F., Badino, S.F., Sørensen, T.H., Cavaleiro, A.M., Borch, K., Westh, P., A steady-state approach for inhibition of heterogeneous enzyme reactions, (2020) *Biochemical Journal*, 447 (10), pp. 1971-1982.
- P6 Olsen, J.P., Kari, J., Windahl, M.S., Borch, K., Westh, P., Molecular recognition in the product site of cellobiohydrolase Cel7A regulates processive step length (2020) *Biochemical Journal*, 477 (1), pp. 99-110.
- P7 Røjel, N., Kari, J., Sørensen, T.H., Badino, S.F., Morth, J.P., Schaller, K., Cavaleiro, A.M., Borch, K., Westh, P., Substrate binding in the processive cellulase Cel7A: Transition state of complexation and roles of conserved tryptophan residues (2020) *Journal of Biological Chemistry*, 295 (6), pp. 1454-1463

- P8 [Kari, J.](#), Christensen, S.J., Andersen, M., Baiget, S.S., Borch, K., Westh, P., A practical approach to steady-state kinetic analysis of cellulases acting on their natural insoluble substrate (2019) *Analytical Biochemistry*, 586, 113411
- P9 Schiano-di-Cola, C., Røjel, N., Jensen, K., [Kari, J.](#), Sørensen, T.H., Borch, K., Westh, P., Systematic deletions in the cellobiohydrolase (CBH) Cel7A from the fungus *Trichoderma reesei* reveal flexible loops critical for CBH activity (2019) *Journal of Biological Chemistry*, 294 (6), pp. 1807-1815.
- P10 [Kari, J.](#), Olsen, J.P., Jensen, K., Badino, S.F., Krogh, K.B.R.M., Borch, K., Westh, P., Sabatier Principle for Interfacial (Heterogeneous) Enzyme Catalysis (2018) *ACS Catalysis*, 8 (12), pp. 11966-11972.
- P11 Christensen, S.J., [Kari, J.](#), Badino, S.F., Borch, K., Westh, P. Rate-limiting step and substrate accessibility of cellobiohydrolase Cel6A from *Trichoderma reesei* (2018) *FEBS Journal*, 285 (23), pp. 4482-4493.
- P12 Westh, P., Borch, K., Sørensen, T., Tokin, R., [Kari, J.](#), Badino, S., Cavaleiro, M.A., Røjel, N., Christensen, S., Vesterager, C.S., Schiano-di-Cola, C., Thermoactivation of a cellobiohydrolase (2018) *Biotechnology and Bioengineering*, 115 (4), pp. 831-838
- P13 Andersen, M., [Kari, J.](#), Borch, K., Westh, P., Michaelis-Menten equation for degradation of insoluble substrate (2018) *Mathematical Biosciences*, 296, pp. 93-97.
- P14 Borisova, A.S., Eneyskaya, E.V., Jana, S., Badino, S.F., [Kari, J.](#), Amore, A., Karlsson, M., Hansson, H., Sandgren, M., Himmel, M.E., Westh, P., Payne, C.M., Kulminskaya, A.A., Ståhlberg, J., Correlation of structure, function and protein dynamics in GH7 cellobiohydrolases from *trichoderma atroviride*, *T. reesei* and *T. Harzianum* (2018) *Biotechnology for Biofuels*, 11 (1), 5.
- P15 Badino, S.F., [Kari, J.](#), Christensen, S.J., Borch, K., Westh, P., Direct kinetic comparison of the two cellobiohydrolases Cel6A and Cel7A from *Hypocrea jecorina* (2017) *Biochimica et Biophysica Acta - Proteins and Proteomics*, 1865 (12), pp. 1739-1745.
- P16 Olsen, J.P., [Kari, J.](#), Borch, K., Westh, P., A quenched-flow system for measuring heterogeneous enzyme kinetics with sub-second time resolution (2017) *Enzyme and Microbial Technology*, 105, pp. 45-50.
- P17 Badino, S.F., Christensen, S.J., [Kari, J.](#), Windahl, M.S., Hvidt, S., Borch, K., Westh, P., Exo-exo synergy between Cel6A and Cel7A from *Hypocrea jecorina*: Role of carbohydrate binding module and the endo-lytic character of the enzymes (2017) *Biotechnology and Bioengineering*, 114 (8), pp. 1639-1647.
- P18 [Kari, J.](#), Andersen, M., Borch, K., Westh, P., An Inverse Michaelis-Menten Approach for Interfacial Enzyme Kinetics (2017) *ACS Catalysis*, 7 (7), pp. 4904-4914.
- P19 [Kari, J.](#), Kont, R., Borch, K., Buskov, S., Olsen, J.P., Cruys-Bagger, N., Våljamäe, P., Westh, P., Anomeric selectivity and product profile of a processive cellulase (2017) *Biochemistry*, 56 (1), pp. 167-178.
- P20 Sørensen, T.H., Windahl, M.S., McBrayer, B., [Kari, J.](#), Olsen, J.P., Borch, K., Westh, P., Loop variants of the thermophile *Rasamsonia emersonii* Cel7A with improved activity against cellulose (2017) *Biotechnology and Bioengineering*, 114 (1), pp. 53-62.
- P21 Kont, R., [Kari, J.](#), Borch, K., Westh, P., Våljamäe, P., Inter-domain synergism is required for efficient feeding of cellulose chain into active site of cellobiohydrolase cel7A (2016) *Journal of Biological Chemistry*, 291 (50), pp. 26013-26023.
- P22 Olsen, J.P., Alasepp, K., [Kari, J.](#), Cruys-Bagger, N., Borch, K., Westh, P., Mechanism of product inhibition for cellobiohydrolase Cel7A during hydrolysis of insoluble cellulose (2016) *Biotechnology and Bioengineering*, 113 (6), pp. 1178-1186
- P23 Colussi, F., Sorensen, T.H., Alasepp, K., [Kari, J.](#), Cruys-Bagger, N., Windahl, M.S., Olsen, J.P., Borch, K., Westh, P., Probing substrate interactions in the active tunnel of a catalytically deficient cellobiohydrolase (Cel7) (2015) *Journal of Biological Chemistry*, 290 (4), pp. 2444-2454.
- P24 [Kari, J.](#), Olsen, J., Borch, K., Cruys-Bagger, N., Jensen, K., Westh, P., Kinetics of cellobiohydrolase (Cel7A) variants with lowered substrate affinity (2014) *Journal of Biological Chemistry*, 289 (47), pp. 32459-32468.

## LIST OF WORKING PAPERS

- W1 Schaller, K., Molina, G. A., [Kari, J.](#), Schiano-di-Cola, C., Sørensen, T.H., Borch, K., Peters, G., Westh, P. Virtual Bioprospecting of Enzymes - Relating Sequence and Kinetics (Submitted to PNAS)
- W2 [Kari, J.](#), Molina, G. A., Schaller, K., Schiano-di-Cola, C., Borch, K., Westh, P. Physical constrain control temperature dependency of cellulases and provide new strategies for enzyme design.

- W3 Molina, G., Kari, J., A., Schaller, K., Schiano-di-Cola, C., Borch, K., Westh, P. Effects of cellulose crystallinity on linear scaling relationships of cellulases
- W4 Schaller, K., Molina, G. A., Kari, J., Schiano-di-Cola, C., Sørensen, T.H., Borch, K., Peters, G., Westh, P. In silico driven design of a carbohydrate-binding module for tuning the affinity and activity of cellobiohydrolase Cel7A
- W5 Schiano-di-Cola, C., Kari, J., Molina, G., Agger, J., Sørensen, T.H., Morth, P., Borch, K., Westh, P., The endoglucanase Cel7B from *Trichoderma reesei*: kinetics and mode of action on insoluble cellulose

**Papers under development (Early drafts)**

- U1 Effect of binding heterogeneity for protein-ligand stability and kinetics. (Preliminary results)
- U2 Inverse Selwyn test – A simple test for substrate stability during the enzymatic breakdown of insoluble substrate.
- U3 Tuning affinity and activity of Interfacial enzyme by electrostatic interactions. Effect of enzyme and substrate surface charge. (Preliminary results)
- U4 Enzyme synergy is an evolved strategy to break linear scaling relations in heterogeneous biocatalysis. (Preliminary results)