

# Dr. Hatem Abushammala | Fraunhofer Institute (WKI)

## Wilhelm-Klauditz Research Fellow in Nanomaterials and Polymers



**Date, Place of Birth:** 26.11.1985, Oman Sultanate | **Marital Status:** Single

**Address:** Braunschweig, Germany

**Email:** [habushammala@gmail.com](mailto:habushammala@gmail.com) | **ORCID:** [orcid.org/Hatem](https://orcid.org/Hatem)

- Materials Chemist with 10 years of research experience in the field of bio-based nanomaterials.
- Laureate of the prestigious Wilhelm-Klauditz Fellowship from the Fraunhofer Institute for Wood Research (WKI).
- Laureate of four German and international prestigious awards for outstanding research (2015, 2016, 2017).
- Author of three patents, fifteen research articles, one book chapter, and many conference talks and posters.
- Strong experience in operating a wide range of instrumental techniques for materials processing and characterization.
- Excellent skills in designing and managing research projects and supervising junior researchers.
- Seven years of experience in teaching and developing courses in materials chemistry and engineering.

### Professional Experience

#### Wilhelm-Klauditz Research Fellow

2017 - Now

Fraunhofer Institute for Wood Research WKI – Germany

**E-CNCs Project:** Development of Electrically Conductive Nanocellulose using Insulate Reagents and its Potential in Electronics, Sensing, Pharmaceutical and Medical Applications.

**Innorenew Project:** Development of Bio-based Insulation and Phase Change Materials for Sustainable Buildings.

#### Postdoctoral Research Associate and Lecturer

2015 - 2016

University of Freiburg, Chair of Forest Biomaterials – Germany

**AIF Project:** Novel Processing of Nanocellulose, Starch, and Bio-based Polyethylene for the Development of Novel Bioplastics. (Cooperation with Industry and Academia)

**Lignosit Project:** The Development of Liquid Crystal-Based Bionic Nanocomposites of Lignin and Nanocellulose for 3D Printing.

**Teaching:** M.Sc. Level Courses: Biopolymers and Bioresources, Utilization and Fractionation of Bioresources, Nanocellulose: Fundamentals, Production, Modification, Processing, and Applications, Labs on Wood Physics and Viscoelasticity, and on Bio-based Products.

#### Research Assistant

2012 - 2015

University of Freiburg, Chair of Forest Biomaterials – Germany

**NoPa Project:** Valorization of Harvesting Residues from the Amazonian Rain Forest in Brazil into High-Value Nanocellulosic Materials. (German-Brazilian Research Cooperation).

#### Research and Teaching Assistant

2009 - 2011

Masdar Institute of Science and Technology – UAE

Structural Modification of Cellulose, Ionic Liquids, Characterization of Polymers, Enzymatic Hydrolysis, Biofuel Production, Pharmaceutical Formulation, Drug Delivery Systems. Teaching of Electrochemical Processing of Materials & Structure and Properties of Polymers.

#### Pharmaceutical Chemist

2008 - 2009

Hikma Pharmaceuticals Company – Jordan and Portugal  
Analytical Research Department  
Analytical Method Validation

#### Pharmaceutical Chemist

2007 - 2008

Jordanian Pharmaceutical Manufacturing Company – Jordan  
Research and Development Department  
Analytical Method Validation and Raw Material Analysis

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## Education

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**Dr. Bio-based Materials and Polymers (University of Freiburg, Germany) 03/2012 - 02/2015**

- **Thesis:** Novel Ionic Liquid-Mediated Technologies for the Extraction of Nanocellulose Directly from Wood
- **Sigrid- and Viktor-Dulger Prize 2017** by the University of Heidelberg
- **Gold Medal 2016** by the International Academy of Wood Science (IAWS)
- **Hansjürg-Steinlin Prize 2016** by the University of Freiburg
- **Leo-Schörghuber Prize 2015** by the Technical University of Munich

**M.Sc. Materials Science and Engineering (Masdar Institute / MIT, UAE / USA) 09/2009 - 05/2011**

- **Thesis:** Networked Cellulose for Pharmaceutical Formulation and Biofuel Production
- **Outstanding Master Thesis Award 2011** by Masdar Institute

**B.Sc. Chemistry (Hashemite University, Jordan) 10/2003 - 06/2007**

- **Four Times on Honor List** for Outstanding Academic Performance

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## Instrumental Techniques

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|---------------------|-------------------------------|---------------------|-------------------|
| • X-ray Diffraction | • Liquid- and Solid-State NMR | • AFM               | • TEM             |
| • SEM               | • FT-IR                       | • UV/VIS            | • GPC             |
| • TGA               | • DSC                         | • DMA               | • Contact Angle   |
| • Tensiometry       | • Nanoindentation             | • Mass Spectrometry | • BET             |
| • Extrusion         | • Injection Molding           | • Hot Pressing      | • Electrospinning |
| • Tensile Testing   | • HPLC-UV, RID, PDA           | • Refractometry     | • Polarimetry     |

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## Professional Involvement

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### International Scientific Membership

- The American Chemical Society (ACS), Cellulose Division (CELL)
- European Polysaccharide Network of Excellence (EPNOE)

### Reviewer for International Journals

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|--------------------------------------|--|------------|-------------|
| • Carbohydrate Polymers              | • European Journal of Wood and Wood Products |            |             |
| • Cellulose Chemistry and Technology | • Langmuir                                   | • Polymers | • Materials |

### International Cooperation

- **Prof. Thomas Rosenau**, University of Natural Resources and Life Sciences, Vienna, Austria
- **Prof. Aji Mathew**, Lulea University of Technology, Lulea, Sweden
- **Prof. Rossana Thire**, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil
- **Prof. Fabiano Pereira**, Federal University of Minas Gerais, Minas Gerais, Brazil

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## Skills and Expertise

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### Language Skills

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| • English (Fluent) | • German (Fluent) | • Chinese (Basic) | • Arabic (Native) |
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### Computer Skills

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|----------|-----------|------------|----------|--------------------|-------------|
| • Origin | • EndNote | • ChemDraw | • Matlab | • Visual Basic.NET | • MS Office |
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### Research and Management Certificates

- |                               |                                      |  |
|-------------------------------|--------------------------------------|--|
| • Research Project Management | • Data Analysis and Statistics       | • Powerful Scientific Presentations    |
| • Scientific Writing          | • Teaching in English                | • How to Develop a Successful Proposal |
| • Self-Management             | • Communicating Science to the Media |  |

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## List of Publications

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### Research Articles

- **H. Abushammala**. A Simple Method for the Quantification of Free Isocyanates on the Surface of Cellulose Nanocrystals upon Carbamation using Aromatic Diisocyanate (TDI). *Surfaces*, **2019**. Accepted.
- J. Mao, B. Heck, **H. Abushammala**, G. Reiter, M.-P. Laborie. A Structural Fibrillation Parameter from Small Angle X-ray Scattering to Quantify Pulp Refining. *Cellulose*, **2019**; 26 (7): 4265-4277.
- **H. Abushammala**, T. Zweckmair, H. Hettegger, M. Bacher, A. Potthast, T. Rosenau, M.-P. Laborie. On the Mechanism of the Unwanted Acetylation of Polysaccharides by 1, 3-dialkylimidazolium Acetate Ionic Liquids: Part 2 – The Impact of Lignin on the Kinetics of Cellulose Acetylation. *Cellulose*, **2017**; 24 (7): 2767-2774.
- J. Mao, **H. Abushammala**, H. Hettegger, T. Rosenau, M.-P. Laborie. Imidazole, a New Tunable Reagent for Producing Nanocellulose, Part I: Xylan-Coated CNCs and CNFs. *Polymers*, **2017**; 9 (10): 473.
- J. Mao, **H. Abushammala**, L.-B. Pereira, M.-P. Laborie. Swelling and Hydrolysis Kinetics of Kraft Pulp Fibers in Aqueous 1-butyl-3-methylimidazolium Hydrogen Sulfate Solutions. *Carbohydrate Polymers*, **2016**; 153: 284-291.
- **H. Abushammala**, R. Goldsztajn, A. Leao, M.-P. Laborie. Combining Steam Explosion with 1-ethyl-3-methylimidazolium Acetate Treatment of Wood Yields Lignin-Coated Cellulose Nanocrystals of High Aspect Ratios. *Cellulose*, **2016**; 23 (3): 1813-1823.
- T. Zweckmair, H. Hettegger, **H. Abushammala**, M. Bacher, A. Potthast, M.-P. Laborie, T. Rosenau. On the Mechanism of the Unwanted Acetylation of Polysaccharides by 1, 3-dialkylimidazolium Acetate Ionic Liquids: Part 1 - Analysis, Acetylating agent, Influence of Water, and Mechanistic Considerations. *Cellulose*, **2015**; 22 (6): 3583-3596.
- **H. Abushammala**, J. F. Pontes, G. H. Gomes, A. Osorio-Madrado, R. Thiré, F. Pereira, M.-P. Laborie. Swelling, Viscoelastic, and Anatomic Studies of Ionic Liquid-Swollen Norway Spruce as a Screening Tool towards Ionosolv Pulping. *Holzforschung*, **2015**; 69 (9): 1059-1067.
- **H. Abushammala**, I. Krossing, M.-P. Laborie. Ionic Liquid-Mediated Technology for Cellulose Nanocrystals Production directly from Wood. *Carbohydrate Polymers*, **2015**; 134: 609-616.
- **H. Abushammala**, H. Winter, I. Krossing, M.-P. Laborie. On the Prevalence of Side Reactions during Ionosolv Pulping of Norway Spruce with 1-butyl-3-methylimidazolium Acesulfamate. *Cellulose*, **2014**; 21(6): 4607-4619.
- S. Pirani, **H. Abushammala**, R. Hashaikh. Preparation and Characterization of Electrospun PLA/Nanocrystalline Cellulose-based Composites. *Applied Polymer Science*, **2013**; 130(5): 3345-3354.
- **H. Abushammala**, R. Hashaikh, C. Cooney. Microcrystalline Cellulose Powder Tableting via Networked Cellulose-Based Gel Material. *Powder Technology*, **2012**; 217: 16-20.
- **H. Abushammala**, R. Hashaikh. Enzymatic Hydrolysis of Cellulose and the Use of TiO<sub>2</sub> Nanoparticles to Open Up the Cellulose Structure. *Biomass and Bioenergy*, **2011**; 35(9): 3970-3975.
- R. Hashaikh, **H. Abushammala**. Acid Mediated Networked Cellulose: Preparation and Characterization. *Carbohydrate Polymers*, **2010**; 83(3):1088-1094.

### Patents

- **H. Abushammala**. The Development of Electrically Conductive Cellulose Nanocrystals using Insulate Reagents. **2019**, Filed.
- **H. Abushammala**, M.-P. Laborie. Ionic Liquid-Mediated Production of Cellulose Nanocrystals Directly from Wood, Grass, or Bioresidues. **2016**, WO2016139356.
- **H. Abushammala**, R. Hashaikh. Cellulosic Gel Material as a Pharmaceutical Excipient, **2013**, WO 2013033815.

### Book Chapters

- J. Mao, **H. Abushammala**, N.R. Brown, M.-P. Laborie. Comparative Assessment of Methods for Producing Cellulose I Nanocrystals from Cellulosic Sources. Book Title: Nano-cellulose, their Preparation, Properties, and Applications. ACS Books, ISBN13: 9780841232181, **2017**; Chapter 2, 19-53.

### Conference Talks and Posters

- **H. Abushammala**. The Production of Electrically Conductive Nanocellulose and its Potential. World Nanotechnology Conference, **2019**, Dubai, UAE. **Talk**
- J. Mao, **H. Abushammala**, B. Heck, G. Reiter. M.-P. Laborie. Monitoring Structural Changes during Fibrillation of Cellulose Pulp into Cellulose Nanofibrils (CNFs). 253<sup>th</sup> American Chemical Society (ACS) National Meeting and Exposition on Advanced Materials, **2017**, USA. **Talk**

- J. Mao, **H. Abushammala**, H. Hettegger, T. Rosenau. M.-P. Laborie. A New Tunable Reagent for Producing Nanocellulose. 253<sup>th</sup> American Chemical Society (ACS) National Meeting and Exposition on Advanced Materials, **2017**, USA. **Talk**
- **H. Abushammala**, M.-P. Laborie. Turning Forest Waste into High-Value Materials: Nanocellulose. Forstwissenschaftliche Tagung (FowiTa), **2016**, Germany. **Talk**
- **H. Abushammala**, I. Krossing, M.-P. Laborie. Novel Ionic Liquid-Mediated Technology for Cellulose Nanocrystals Production Directly from Wood. FP 1105 COST Training School on Understanding Wood Cell Wall Structure, Biopolymer Interaction and Composition, **2015**, Switzerland. **Talk**
- N. Polikarpov, T. Arndt, M. Duhme, **H. Abushammala**, J. Mao, E. Stibal, M.-P. Laborie. Nanofibrillated Cellulose-Paper and Composites. PTS Fachseminar: Nanotechnologie bei der Papierherstellung, **2015**, Munich, Germany. **Talk**
- **H. Abushammala**, I. Krossing, M.-P. Laborie. Facile Ionic Liquid-Mediated Technology for Cellulose Nanocrystals Production Directly from Wood. FP 1205 COST Training School on the Pretreatment and Dissolution of Cellulose, **2015**, Germany. **Talk**
- J. Mao, **H. Abushammala**, L. Pereira, R. Thire, H. Winter, M.-P. Laborie. Solvent/Substrate Behavior between Pulp Fibers and 1-Butyl-3-methylimidazolium Hydrogen Sulfate. FP 1205 COST Training School on the Pretreatment and Dissolution of Cellulose, **2015**, Germany. **Talk**
- **H. Abushammala**, I. Krossing, M.-P. Laborie. Facile Ionic Liquid-Mediated Technology for Cellulose Nanocrystals Production Directly from Wood. 249<sup>th</sup> American Chemical Society (ACS) National Meeting and Exposition on the Chemistry of Natural Resources, **2015**, USA. **Talk**
- **H. Abushammala**, M.-P. Laborie. Bionisches Lignozellulose-Nanocomposit mit innovativem Verarbeitungskonzept zur Verbesserung der physikalischen Leistungsfähigkeit. Bioeconomy Congress Baden Württemberg, **2014**, Germany. **Poster**
- **H. Abushammala**, I. Krossing. M.-P. Laborie. The Degradation of the Acesulfamate Anion during the Treatment of Norway Spruce Wood with 1-butyl-3-methylimidazolium Acesulfamate Ionic Liquid. EPNOE Conference, **2013**, France. **Poster**
- **H. Abushammala**, J. F. Pontes, G. H. Gomes, A. Osorio-Madrado, I. Krossing. M.-P. Laborie. Swelling and Viscoelastic Studies of Norway Spruce: Combining Tools to Study Ionic Liquid-Wood Molecular Interactions towards Organosolv Pulping. Memowood Conference, **2013**, France. **Talk**
- **H. Abushammala**. J. F. Pontes, G. H. Gomes, A. Osorio-Madrado, I. Krossing, M.-P. Laborie. Towards Organosolv Pulping of Norway Spruce for Nanocellulose Production: Swelling Kinetics and Viscoelastic Study. TAPPI Conference, **2013**, Sweden. **Poster**
- R. Hashaikeh, **H. Abushammala**, P. Krishnamachari, Charles Cooney. Upgrading Cellulosic Resources as Specialty Polymers. ICMAT Conference, **2011**, Singapore. **Talk**
- **H. Abushammala**, R. Hashaikeh. Networked Cellulose as a Pharmaceutical Excipient. Nanocon Conference, **2010**, Czech Republic. **Talk**

#### Supervised Doctoral & Master Theses and Internships

- **Lisa Ebers**, M.Sc. Thesis, The Impact of Cellulose Morphology upon Defibrillation on the Thermal Properties of Bio-based Polyethylene and Thermoplastic Starch, **2016**.
- **Chinmoyee Das**, M.Sc. Thesis, Lignin-based Composites with Improved Interfacial Adhesion using Lignin-Coated Nanocellulose, **2016**.
- **Pu Ke**, M.Sc. Thesis, Extraction of Cellulose Nanocrystals from Different Lignocelluloses using Ionic Liquids, **2016**.
- **Sona Othman**, Internship, Surface Energy Parameters of Cellulose with Varying Degrees of Acetylation, **2016**.
- **Yoann Magre**, Internship, Surface Energy Parameters of Cellulose upon Varying Fibrillation using an Extruder, **2015**.
- **Nicolas Renouard**, Internship, The Viscoelastic Behavior of Cellulose upon Varying Fibrillation using an Extruder, **2015**.
- **Ruben Goldsztajn**, M.Sc. Thesis, Optimization of Steam Explosion of Macaranduba Wood towards the Extraction of Nanocellulose, **2014**.
- **Felipe Pontes**, Internship, The Swelling and Viscoelastic Behavior of Norway Spruce in 1-ethyl-3-methylimidazolium Acetate Ionic Liquid, **2013**.
- **Gustavo Henrique**, Internship, The Swelling and Viscoelastic Behavior of Norway Spruce in 1-butyl-3-methylimidazolium Acesulfamate Ionic Liquid, **2012**.