Research Strategy
Our core activities involve biobased materials at different size scales, mainly those displaying large interfacial areas such as fibers (micro/nano fibers), fiber networks, particles, colloids and multiphase systems.

Focus areas
- Nano/microfibrillar ligno-cellulose, nanocrystals & bacterial cellulose. Nanochitin and dairy colloids
- Multiphase systems: dispersions, foams, gels, membranes and aerogels.
- Stimuli-responsive materials.
- Proteins, enzymes and (bio)sensing.
Highlights of 2018 (5)

Joined in 2018 (14): Postdocs, PhD and MS students

2018 Graduates (7)

Visiting scholars, short and long term (20)

Awards and personnel highlights

Committee membership (12)

Opponent duties (4)

Evaluations for promotion (6)

Papers published in peer-review journals (46)

Book and book chapters (4)

Conferences and Invited seminars (> 48)

Editorial activities
# 2018 highlight 1

**Biobased Colloids and Materials (BiCMat) group**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Biofabrication of multifunctional nanocelullosic 3D structures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What?</strong></td>
<td>Novel approach to integrate biofilms in the development of advanced materials</td>
</tr>
<tr>
<td><strong>How?</strong></td>
<td>Cellulose-producing microorganisms form membranes inside designed shapes that follow the “liquid marble” framework</td>
</tr>
<tr>
<td><strong>Possible application</strong></td>
<td>Tissue engineering, biomedical; organ (bio)printing; capsule-in-capsule solutions; multi-compartmentalization; food</td>
</tr>
</tbody>
</table>

# 2018 highlight 2

Biobased Colloids and Materials (BiCMat) group

<table>
<thead>
<tr>
<th>Topic</th>
<th>High axial ratio nanochitins for ultra-strong and shape-recoverable hydrogels and cryogels</th>
</tr>
</thead>
<tbody>
<tr>
<td>What?</td>
<td>Nanochitin is produced at low energy and high yield (~90%) to produce ultra-elastic hydrogels and cryogels</td>
</tr>
<tr>
<td>How?</td>
<td>Following hydrolysis for partial deacetylation of chitin, nanofibrils ultra-high axial size (500) are produced. Ice templating upon freezing and thawing is performed with simultaneous crosslinking.</td>
</tr>
</tbody>
</table>

Possible application

Antibacterial and antifungal systems for thermal insulation and air filtration. Drug delivery.
## 2018 highlight 3
Biobased Colloids and Materials (BiCMat) group

<table>
<thead>
<tr>
<th>Topic</th>
<th>CNC for structural color and coffee rings effects via drying flux inhomogeneities</th>
</tr>
</thead>
<tbody>
<tr>
<td>What?</td>
<td>Cross-disciplinary work with ART and CHEM to exploit coffee ring effects from cellulose nanocrystals and produce visual designs</td>
</tr>
<tr>
<td>How?</td>
<td><img src="image" alt="Diagrams" /></td>
</tr>
</tbody>
</table>

## 2018 highlight 4
Biobased Colloids and Materials (BiCMat) group

<table>
<thead>
<tr>
<th>Topic</th>
<th>Micro- and nanocelluloses for the synthesis of highly-stretchable, tough and water-resistant co-continuous filaments</th>
</tr>
</thead>
<tbody>
<tr>
<td>What?</td>
<td>Heterogeneous acetylation of wood fibers weakens interfibrillar hydrogen bonding, which facilitates microfluidization and formation of continues filaments</td>
</tr>
<tr>
<td>How?</td>
<td>Suspension forms a co-continuous assembly with a matrix that interacts strongly with the micro- and nanofibrils in the dispersed phase. This facilitates uninterrupted and defect-free wet-spinning.</td>
</tr>
</tbody>
</table>

Tripathi, Ago, Khan, Rojas, *ACS Applied Materials and Interfaces*, Accepted (2019)

| Possible application | Advanced filaments that are water resistant, with remarkable stretchability (30 %) and ultra-high toughness. |
# 2018 highlight 5

**Biobased Colloids and Materials (BiCMat) group**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Short and long nanochitin for oil/water interfacial super-stabilization and 3D printing</th>
</tr>
</thead>
<tbody>
<tr>
<td>What?</td>
<td>Nanochitins of various aspect ratio are produced and used to achieve super-stable emulsions</td>
</tr>
<tr>
<td>How?</td>
<td><img src="image" alt="Diagram of nanochitin production and 3D printing" /></td>
</tr>
<tr>
<td>Possible application</td>
<td>Structural food; 3D printing and advanced materials</td>
</tr>
</tbody>
</table>
5 BiCMat senior members and postdocs joined in 2018
1. Johanna Majoinen, Surface functionalization, Polymer self-assembly
2. Jukka Hassinen, Nanoparticle clusters (current, manager CERES Flagship)
3. Rafael Grande, Interpolyelectrolyte complexes
4. Bruno Mattos, supracolloids, controlled release
5. Robertus Nugroho, Biocolloidal powders

7 BiCMat PhD students joined in 2018
1. Bin Zhao – Ph.D., Bioproducts and Biosystems, Chem. Eng, Aalto University
3. Ya Zhu – Ph.D., Bioproducts and Biosystems, Chem. Eng, Aalto University (with College of Material Science and Engineering, Northeast Forestry University, China)
5. Saara Lähtevänoja – Ph.D., Bioproducts and Biosystems, Chem. Eng, Aalto University

2 BiCMat MS & Licentiate students joined in 2018
1. Mikko Laine (current) – M.S., Bioproducts and Biosystems, Chem. Eng, Aalto University:
2. Olli Lehtinen (current) – Licentiate., Bioproducts and Biosystems, Chem. Eng, Aalto University

Summer and temporal researchers
Stefan Winklehner, Mahdi Rafiee, Amal Ishfaq, Michael Rale
7 BiCMat members graduated (PhD)


4. Anurodh Tripathi (NCSU, USA) – Ph.D., Chemical and Biomolecular Engineering, NCSU: Porous and light-weight cellulose diacetate structures for environmental remediation, July 2018 (co-advisor: Prof. Saad Khan)

5. Joe Lavoie (Glen Raven, USA) – Ph.D., Chemical and Biomolecular Engineering, NCSU: Approaches for Surface Energy Control of Nonwoven Fibers for Alcohol Repellency and Electret Charge Protection, February 2018 (co-advisor: Prof. Saad Khan).

6. Prajesh Adhikari (Intel, USA) – Ph.D., Chemical and Biomolecular Engineering, NCSU: Developing New Multicomponent Systems: From Coatings, Gels to Nanofiller Composites, January 2018 (co-advisor: Prof. Saad Khan).
5 BiCMat members graduated (M.S.)


21 Visiting Scholars Hosted by the Group in 2016

1. Hongbin Xie, School of Bioresources Chemical and Materials Engineering, Shaanxi University of Science and Technology
2. Lin Li, School of Bioresources Chemical and Materials Engineering, Shaanxi University of Science and Technology
3. Peiyao Wang, School of Bioresources Chemical and Materials Engineering, Shaanxi University of Science and Technology
4. Xiaoli Zhen, School of Bioresources Chemical and Materials Engineering, Shaanxi University of Science and Technology
5. Gabriela Berto, Escola de Engenharia de Lorena, Universidade de São Paulo
6. Xiao Zhang, College of Material Science and Engineering, Northeast Forestry University, Design and Preparation of functionalized lignin supramolecular microparticles for stabilizing Pickering emulsion and emulsion polymerization
7. Yang Meng, College of Materials Science and Technology, Beijing Forestry University (BFU), Phase changing materials from lignocellulose
8. Carlos Eduardo Silveira da Silva, Ciências Ambientais e Florestais, UFRRJ, Brasil
9. Gabriela L. Berto, Biomass deconstruction
10. Prof. Michael Tam, University of Waterloo, Canada, 3 months
11. Elisa Boutonnet, Pagora - Grenoble-INP, France, 2 months
12. Judith Vergara, Ph.D. student, University of Bio-Bio, Chile, 2 months
13. Alexander Gaitan, Ph.D. student, University of Bio-Bio, Chile, 2 months
14. Niu Xun, Ph.D. student, College of Chemical Engineering, Nanjing Forestry University, 6 months
15. Nabila Febriani, Ph.D. student, Advanced Textile Engineering Department, Shinshu University, South Korea, 5 months
Visiting Scholars Hosted by the Group in 2016

16. Antonio Maria Borrero Lopez. Ph.D. student, Química Física y Ciencia de los Materiales, Universidad de Huelva, Spain, 3 months

17. Carmen Hervés. Ph.D. student, ute for Advanced Chemistry of Catalonia, Spanish National Research Council, Spain, 3 months

18. Prof. Guihua Yang, Qilu University, China, Nanocomposites, 3 months.

19. Prof. Haiming Li, Dalian Polytechnic University, Nanocellulose in 3D printing, 1 year

20. Dr. Marco Beaumont, University of Natural Resources and Life Sciences (BOKU), Vienna, Austria, Cellulose Nanoparticles, 2 months

21. Jorge Luengo, CMPC, Chile
Awards and personnel highlights 2018

- Distinguished Professor, College Chem. Engineering, Nanjing Forestry University, China.
- Anselme Payen Award, highest honor in the area of Cellulose and Renewable Materials
- Act of the Year 2018, Aalto University
- EU Commission ERC Advanced grant, the most competitive project award in the EU for established scientists
- Academy of Finland FinnCERES Bioeconomy Flagship (2018-)

<table>
<thead>
<tr>
<th>CERES Flagship – Competence Center for the materials Bioeconomy: A Flagship for our Sustainable Future (Aalto University, VTT Technical Research Centre of Finland Ltd)</th>
<th>Academy of Finland</th>
<th>9,332,800 (1st term) (total of 24 MEUR for 8 years until 2025)</th>
<th>01.05.2018 - 31.12.2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioELCell-Bioproducts Engineered from Lignocelluloses: from plants and upcycling to next generation materials, 788489</td>
<td>European Research Commission - ERC Advanced Grant</td>
<td>2,500,000</td>
<td>01.08.2018 - 31.07.2023</td>
</tr>
</tbody>
</table>
Awards and personnel highlights 2018 (Cont’d)

1. Annamari Jukkola starts Mö Foods Oy
2. Luiz Greca: 2nd term CHEM Fellowship Aalto Doctoral Program in Chemical Technology, Aalto University (based on competitive projects)
4. Blaise Tardy best oral presentation Department Seminar
5. Ling Wang travel PI award
6. Wenchao Xiang PI travel award
7. Janika Lehtonen, fellowship to Australia
   Blaise most productive HYBER member (postods pool)
   Luiz most productive HYBER member (PhDs student pool)
Committee membership

1. Aalto University Materials Platform, chair
2. Tappi Research Committee Nanotechnology of Renewable Materials, co-chair
3. Serra Húnter Programme (SHP) fostered by the Government of Catalonia and the Catalan public universities for Appointment of Assistant Professor in UPC-Terrassa

PhD Committees:
1. Diana Rayes, Department of Chemistry, Umeå University, 2018
2. Selin Vitas, ETH Zürich, Institute for Building Materials, Wood Materials Science
3. Petteri Parkkila, University of Helsinki, 2018 (1)
4. Engku Arisyah Binti Tengku Yasim Anuar, Universiti Putra Malaysia, 2018


4. Patrick Laurén, “Biomedical applications of nanofibrillar cellulose”, Division of Pharmaceutical Biosciences, Faculty of Pharmacy, University of Helsinki, Finland, June 29, 2018.

Evaluation of Promotion and Tenure

1. Lianbiong Hu to the rank of Full Professor, University of Maryland.
2. Mehdi Tajvidi to the rank of Associate Professor in Maine University, USA
3. Carmen Freire, University of Alveiro, Portugal.


Peer-reviewed journal publications 2018 (46), cont’d


Peer-reviewed journal publications 2018 (46), cont’d


44. Reyes G., Borghei M., King A.W.T., Lahti J., Rojas O.J. Cellulose Nanofiber Film Welding using Ionic Liquids, Biomacromolecules, Accepted (2019). DOI: 10.1021/acs.biomac.8b01554


1. Rojas, O.J., Materials Bioeconomy and Solutions from the Forest, Department of Chemistry, University of Aveiro, December 11, 2018, Aveiro, Portugal.
2. Rojas O.J., Back from the Future with the Forest, Y Science 2018, Slush for Life Sciences, December 5, 2018, Helsinki, Finland.
3. Rojas O.J., Key Enabling Nanotechnologies for the Future Bioeconomy, Department of Chemical Engineering, Nanjing Forestry University, November 14, 2018, Nanjing, China
4. Rojas O.J., Prospects and Utilization of Sustainable Nanomaterials derived from Pulp and Paper Streams, The 5th International Conference on Pulping, Papermaking and Biotechnology, November 12-14, 2018, Nanjing, China
5. Rojas O.J., Nanostructured Materials from Cellulose and Lignin, Department of Chemical Engineering, Dalian Polytechnical University, November 16, 2018, Dalian, China
6. Rojas O.J., Nanocellulosics and Nanolignins in Product Development, Department of Chemical Engineering and Materials Science, Jiangnan University, November 19 and 20, 2018, Wuxi, China
7. Rojas O.J., Biobased polymers: material bank for the development of structure, color and function, Stockholm University, School of Chemistry, June 7, 2018
9. Rojas O.J., Biobased polymers: material bank for the development of structure, color and function, Center for Nano-Integration CENIDE, Universität Duisburg-Essen, August 28, 2018, Essen, Germany
10. Rojas O.J., Biobased polymers: material bank for the development of structure, color and function, Joined Department of Chemistry, Wood Science and Chemical and Biological Engineering, University of British Columbia, September 5, 2018, Vancouver, BC, Canada
11. Rojas O.J., Nanostructured materials from cellulose and lignin, Department of Chemistry, Unicamp, October 25, 2018, Campinas, Brazil
12. Rojas, O.J., Nanostructured materials based on renewable polymers, Brazilian National Nanotechnology Institute, October 26, 2018, Campinas, Brazil
13. Rojas, O.J., Materials Bioeconomy and Solutions from the Forest, Department of Chemical Engineering, University of Waterloo, November 02, 2018, Waterloo, Canada
15. Rojas, O.J., Lignin Colloids, Properties and Films: Interfacial properties, LiFT workshop - High-Value Products from Lignin, School of Chemical Engineering, Aalto University, August 23-24, Espoo, Finland.
19. Rojas O.J., Biobased polymers: material bank for the development of structure, color and function, Department of Chemical Engineering, May 31, 2018, Chalmers University, Sweden.
20. Rojas O.J., (Ligno)Cellulose-based nanostructures, characterization, bioapplications and Imaging, Nanomedicines for Biomedical Applications, University of Helsinki, School of Pharmaceutics, May 18, 2018, Helsinki, Finland
25. Facchine E.G., Rojas O.J., Khan S.A., Shear-induced heterogeneity in flocculating micro/nanofibrillated cellulose microstructures American Physical Society in Los Angeles, CA. March 2018


44. Huan S., Tardy B.L., Ago M., Lehtonen J., Rojas O.J., engineering the self-assembly of Cellulose nanocrystals on complex topography to obtain advanced hybrid materials, *International Conference on Nanotechnology for Renewable Materials, TappiNano*, Madison, WI, USA, Canada, June 11-14, 2018

45. Tardy B.L., Rojas O.J., Nanocelluloses and Lignin in food and other emulsions, *International Conference on Nanotechnology for Renewable Materials, TappiNano*, Madison, WI, USA, Canada, June 11-14, 2018

46. Tripathi, A., Khan S., Rojas O.J., Design principles to create porous light-weight materials, *International Conference on*

Editorial Activities (new in 2018)

- Editor-in-Chief of J. Dispersion Science and Technology (2018-)
- Co-editor of Bioresources and Bioproducts (2018-)
- Editorial board of ACS Sustainable Chemistry & Engineering (2018-)