Prof. M.-P. Laborie

Education:
Habilitation, Materials and Process Engineering, Grenoble Institute of Technology, France (2008)
Ph.D, Wood Science and Forest Products, Virginia Polytechnic and State University, USA, (2002)
Master, École Nationale Supérieure des Technologies et Industries du bois (ENSTIB), France (1996)

Research Interests:
cellulosic cell wall; wood biopolymers, bionanocomposites, lignin-based polymers and blends, wood adhesives, cellulose nanofibers, green chemistry, wood viscoelasticity, crystallization

Research Focus Summary:
our research aims at best valorizing natural resources, in particular forest resources, into bonded wood products and innovative biomaterials. Natural materials often rely on a composite architecture, which is hierarchically designed from the molecular to the macroscopic scales to deliver high performance and multiple functionalities. We conduct fundamental and applied research to better understand the structure and the properties of natural materials such as the lignocellulosic cell wall. We then utilize plant-derived biopolymers and other natural polymers to develop new bio-based composites with tailored performance and functions. Overall, three research themes are addressed:

1- Model & characterize the lignocellulosic cell wall structure and properties
2- Model and design interphases in bio-based polymer blends and composites
3- Lab scale formulation and manufacturing of bio-based polymers and (nano)composites with tailored properties and biodegradability

In these lines of research, adhesion science, polymer physical chemistry and viscoelastic modeling are essential tools. We can for instance shed light on biopolymer interactions and interphase morphology by studying the polymer molecular motions and relaxations with solid state NMR and viscoelastic modeling. Using polymer blend approaches, we develop lignin-based materials with tunable thermoplasticity and tannin-based foams with controlled structure and properties. We are also currently developing adhesives, coatings, membranes, miscrostructured thin films etc, based on cellulose and other polysaccharidic nanofibers. For the development of such bionanocomposites, we attempt to manipulate the composite interphase, morphology and properties by integrating nanofiber production with composite manufacture. *in situ* manufacturing techniques such as plasma polymerization, ink jet printing, or bioengineering approaches are in this respect useful green alternatives to solvent-based processes.

Synergistic Activities

- Award chair of the American Chemical Society, Cellulose and Renewable Materials Division (2007-)
- Member of the Editorial board for "Industrial Crops and Product", "Journal of Biobased Materials and Bioenergy", "BioResources" (2005-)
- Technical reviewer for over 30 peer reviewed journals in the field of polymer science, adhesion science, biomaterials and wood and fiber technology (2002-)

Current Funded Projects:

- M.-P. Laborie et al. , BIOFOAMBARK: Converting bark into insulating foams and bioenergy, *ERA NET Program Wood wisdom/ Bioenergy Program,* 01/2012-12/2014
- M.-P. Laborie, Environmentally friendly adhesives based on Cellulose Nanofibers produced from pulp and paper fiber rejects, *Forst und Holz Baden Württemberg*, 02/2011-01/2013
- Englund K., M.-P. Laborie and M. Garcia: A Forest Residue-Based Pyrolysis Biorefinery: thermoplastics from pyrolytic lignin, *US department of Agriculture,* 05/2009-12/2011
- J. Mao, A. Osorio and M.-P. Laborie , Novel extraction methods for cellulose nanofibers based on ionic liquids*, Grammel Foundation*, 03/2011-02/2014
- M. Brioude and M.-P. Laborie, Novel Bio-based Nanocomposites from Polycondensation Reaction and Plasma Polymerization in Presence of Nano- and Micro- Cellulose, *Grammel Foundation*, 10/2011-09/2014
- M.-P. Laborie, Novel Program in Bio-based Polymers and Composites, *Ministry for Education and Research (BMBF)*, 10/2010-10/2014
- I. Bakare and M.-P. Laborie, Isolation and Modification of cellulose nanofibers from Rubberwood, *Deutsche Forschunsgemeinschaft (DFG)*, 9/11-12/11.

Selected Peer Reviewed Publications:

- G. Siqueira, C. Fraschini, J. Bras, A. Dufresne, R. Prud'homme, M.-P. Laborie, 2011. Impact of the nature and shape of cellulosic nanoparticles on the isothermal crystallization kinetics of Poly(ε-caprolactone), *European Polymer Journal*
- A. Sahaf, K. Englund, M.-P. Laborie, 2011. Tack and shear strength of hybrid adhesive systems made of phenol formaldehyde, dextrin and fish glue, and acrylic, pressure-sensitive adhesive, *Holzforschung*, doi: 10.1515/HF.2011.132
- P. Samyn, V. Roucoules, M.-P. Laborie, A. Matthew, A. Airoud, 2011. Plasma deposition of polymer composite films incorporating nanocellulose whiskers, *The European Physical Journal - Applied Physics*, in press.
- E. Brown, J. Zhang, M.-P. Laborie. 2011, Never-dried bacterial cellulose/ fibrin composites: preparation and basic morphological and mechanical properties, *Cellulose* 18 (3), 631-641
- H. Liu, M.-P. Laborie 2011, Bio-based nanocomposites by *in-situ* cure of phenolic prepolymers with cellulose whiskers, *Cellulose* 18 (3), 619-630.
- E. Rude, M.-P. Laborie 2008. ^{13}C CP/MAS NMR investigation of the interactions between maleic anhydride polypropylene and wood polymers, *Appl. Spectroscopy* 62 (5) 562-568.

- M. Maranan, M.-P. Laborie. 2008. Rapid prediction of the chemical traits of hybrid poplar with near infrared spectroscopy, *J. Biobased Materials and Bioenergy* 2 (1) 57-63.
- E. Brown, M.-P. Laborie. 2007. Bioengineering of bacterial cellulose/ polyethylene oxide nanocomposites, *Biomacromolecules* 8 (10) 3074-3081.
- Gupta, I. Reiniati, M.-P. Laborie. 2007. Surface properties and adhesion of wood fiber reinforced thermoplastic polymers, *Colloids and Surfaces A:* 302 (1-3) 388-395.
- M.-P. Laborie, L. Salmén, C.E. Frazier. 2006. A morphological study of the wood/phenol-formaldehyde resin interphase, *J. Adhesion Sci. and Technol*. 20 (8) 729-741.
- J. Wang, M.-P Laborie, M.-P. Wolcott. 2005. Model-free kinetics of the cure of phenol-formaldehyde resins, *Thermochim. Acta* 439 (1-2) 68-73.
- M.-P. Laborie, L. Salmén, C.E. Frazier. 2004. Cooperativity analysis of the *in situ* glass transition of lignin, *Holzforschung* 58 (2) 129-133.

Others (Patents, Books and Book Chapters)

- M.-P. Laborie, B. Gupta 2009. Methods for surface activation of wood-fiber reinforced thermoplastic composites for surface adhesion enhancement and composites having such surface properties; US patent 2009155530 A1 20090618, 13pp.
- E. Brown, M.-P. Laborie 2009. Method of in situ bioproduction and composition of bacterial cellulose nanocomposites; US patent 009192264 A1 20090730, 34pp.
- M.-P. Laborie 2009. Bacterial cellulose & its polymeric nanocomposites, in the book: *Nanoscience & Nanotechnology of Renewable Biomaterials*, Ed. L. Lucia & O. Rojas, Blackwell Pub. pp.231-272
- M.-P. Laborie 2005. The temperature dependence of wood relaxations: a molecular probe of the woody cell wall, in the book *Characterization of the Cellulosic Cell* Wall, Eds. D. Stocke and L. Groom. Blackwell Pub., Ames, Iowa USA, pp. 87-94.