Xavier Morelle

Soft Matter Science & Engineering
Post-Doctoral Researcher

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10^{th} of November, 1988
French, English, Spanish

Current position

2017–now **Post-doctoral researcher at ESPCI**, *Paris – France*, employed by the CNRS through the CHEMEC European Research Council grant.
Fundamental research using mechano-chemistry as a tool to study the mechanics and fracture of soft polymer networks, going from adhesives to hydrogels and elastomers. A focus is set on the understanding of the fatigue behavior and the toughening mechanisms occurring in multiple network hydrogels and elastomers through optical analysis of fluorescent molecular markers. The work is performed in SIMM lab under the supervision of Pr. Creton & Pr. Ciccotti.

Education & Academic achievements

2015–2017 **Post-doctoral fellow at Harvard University**, *Cambridge, Massachusetts – USA*, Cabeaux-Jacobs B.A.E.F. Fellow.
Research in the field of soft active materials in the group of Pr. Zhigang Suo. My research involved the preparation of tough hydrogels, their specific mechanical and fracture characterization under a large variety of testing conditions (from sub-zero temperatures to fatigue loading), as well as the development of new engineering devices making use of their multifunctional properties.

2011–2015 **PhD in Materials Science at UCLouvain**, *Louvain-la-Neuve – Belgium*, Doctoral Research Fellowship by the Belgian National Fund for Scientific Research (FNRS).
Research in materials science with both experimental and modeling work in the field of mechanics of polymers and polymer-based composites. Development of an original physics-based theory for modelling the meso-scale heterogeneous micro-mechanisms of glassy polymers.
Collaborations on applied research projects with the aeronautical industry (Safran group, TechSpace Aero, Sonaca), as well as fundamental research with other international groups (KULeuven, Trinity College, IMDEA, Imperial College), were pursued in parallel.
Dissertation : « Mechanical Characterization and Physics-Based Modeling of a Highly-Crosslinked Epoxy Resin », supervised by Pr. Thomas Pardoen & Pr. Christian Bailly.

2009–2011 **Master degree in Chemistry and Materials Science Engineering**, *UCLouvain*, Louvain-la-Neuve – Belgium, *Summa cum laude*.
Options in *Mechanics of Materials*, and *Polymers & Macromolecules*.
Master thesis on the characterization and modeling of composites for aeronautics.

2010–2011 **Erasmus Student Exchange**, *Eindhoven University of Technology*, Eindhoven – Netherlands, *Summa cum laude*.
5 months stay, including a 2-months research project in the field of nano-composites, supervised by Pr. L.E. Govaert and Pr. J.G.P. Goosens.

2006–2009 **Bachelor degree in Engineering**, *UCLouvain*, Louvain-la-Neuve – Belgium, *Magna cum laude*.
Options in *Mechanics*, and *Applied Physics and Chemistry*.

Teaching experience

2014–2015 **Lecturer for a topical seminar in a Materials science master course**, *Ecole Polytechnique de Louvain – UCLouvain*, Louvain-la-Neuve – Belgium.
A two-hours seminar on the viscoplasticity of polymers, given for an auditorium of 50 engineering students in their 2^{nd} year of master degree.

2011–2015 **Lab assistant in Deformation and Fracture of Materials master course**, *Ecole Polytechnique de Louvain – UCLouvain*, Louvain-la-Neuve – Belgium.
Small theoretical courses and supervision of mechanical testing labs for groups of 20-30 engineering students in their $1st$ year of master degree.

2009–2011 **Teaching assistant in Physcis and Chemistry bachelor courses**, *Ecole Polytechnique de Louvain – UCLouvain*, Louvain-la-Neuve – Belgium.
Monitoring of lab and exercise sessions for 1^{st} and 2^{nd} year undergrad engineering students. Group management learning technics training (72 hours over 3 months).

NB : The provided teaching was performed on a voluntary basis, as my PhD and post-doctoral stays involved full-time research-based activities.

Supervision

at PhD level (not in dissertation committee)

2016–2018 **Jérémy Chevalier**, *UCLouvain*, Louvain-la-Neuve – Belgium.
Mentoring and collaborative work on 3 research projects (all published) on finding an appropriate fracture criterion for highly-crosslinked epoxy resins and developing a physics-based theory for their meso-scale micromechanical modelling.
Dissertation title : « Micromechanics of an epoxy matrix for fiber reinforced composites : experiments and physics-based modelling ».

2016–2017 **Ruobing Bai**, *Harvard University*, Cambridge, MA – USA.
Mentoring and collaborative work on 5 research projects (4 of them published, 1 in preparation) focusing on the fatigue behavior of hydrogels during my stay in Pr. Zhigang Suo group.

at Master level

2014–2015 **Loïc Van Nieuwenhuyse, materials science master student**, *Ecole Polytechnique de Louvain – UCLouvain*, Louvain-la-Neuve – Belgium, *Magna cum laude*.
Relation between physical aging and mechanical properties of an aerospace grade epoxy resin. Feasibility study of an in situ transverse compression test on a UD sample.

2013–2014 **Minh Le Duy, macromolecular nanotechnology master student**, *Ecole Polytechnique de Louvain – UCLouvain*, Louvain-la-Neuve – Belgium, *Cum laude*.
Etude d'hétérogénéités dans les résines époxys (type RTM-6) par microscopie à force atomique (mode HarmoniX).

2012–2013 **Jesus Gutierrez Martinez, mechanical engineering master student**, *Ecole Polytechnique de Louvain – UCLouvain*, Louvain-la-Neuve – Belgium, *Cum laude*.
Time dependent response of RTM6 epoxy resin investigated by mechanical testing and modeling.

at Bachelor level

2016 **Enrui Zhang, visiting research intern**, *School of Engineering and Applied Sciences – Harvard University*, Cambridge, MA – USA.
Co-supervision of his work on the effect of water content on the fatigue resistance of hydrogels during one semester. The performed research lead to a scientific publication and Enrui is now a PhD student at Brown University.

Publications in international peer-reviewed journals (impact factor> 1)

2019

xx. R. Bai, J. Wang, **X. P. Morelle**, Z. Suo, "Flaw-insensitive hydrogels under static and cyclic loads", *submitted to Advanced Materials.*

12. J. Chevalier, **X. P. Morelle**, P. P. Camanho, F. Lani, T. Pardoen, "On a unique fracture mechanism for highly cross-linked epoxy resins", *Journal of Mechanics and Physics of Solids*, vol 122, (2019), pp.502-519. https ://doi.org/10.1016/j.jmps.2018.09.028

2018

11. J. Chevalier, L. Brassart, F. Lani, C. Bailly, T. Pardoen, **X. P. Morelle**, "Unveilling the nanoscale heterogeneity controlled deformation of thermosets", *Journal of the Mechanics and Physics of Solids*, vol 121, (2018), pp. 432-446. https ://doi.org/10.1016/j.jmps.2018.08.014

10. **X. P. Morelle**, W. R. Illeperuma, K. Tian, R. Bai, Z. Suo, J. J. Vlassak, "Highly stretchable and tough hydrogels below water freezing temperatures", *Advanced Materials*, vol 30, (2018), 1801541. https ://doi.org/10.1002/adma.201801541

9. P. Rothemund, **X. P. Morelle**, K. Jia, G. M. Whitesides, Z. Suo, "A transparent membrane for active noise cancelation", *Advanced Functional Materials*, vol 28, (2018), 1800653. https ://doi.org/10.1002/adfm.201800653

8. E. Zhang, R. Bai, **X. P. Morelle**, Z. Suo, "Fatigue fracture of nearly elastic hydrogels", *Soft Matter*, vol 14, (2018), pp. 3563-3571. https ://doi.org/10.1039/C8SL00460A

7. R. Bai, J. Yang, **X. P. Morelle**, C. Yang, Z. Suo, "Fatigue fracture of self-recovery hydrogels", *ACS Macro Letters*, vol 7, (2018), pp. 312-317. https ://doi.org/10.1021/acsmacrolett.8b00045.

2017

6. **X. P. Morelle**, R. Bai, Z. Suo, "Localized deformation in Plastic Liquids on Elastomers", *Journal of Applied Mechanics*, vol. 84 : issue 10, (2017), pp. 101002 https ://doi.org/10.1115/1.4037410.

5. R. Bai, Q. Yang, J. Tang, **X. P. Morelle**, J. Vlassak, Z. Suo, "Fatigue fracture of tough hydrogels", *Extreme Mechanics Letters*, vol 15, (2017), pp. 91-96. https ://doi.org/10.1016/j.eml.2017.07.002.

4. **X. P. Morelle**, J. Chevalier, C. Bailly, T. Pardoen, F. Lani, "Mechanical characterization and modeling of the deformation and failure of the highly crosslinked RTM6 epoxy resin", *Mechanics of Time-Dependent Materials*, vol. 21 : issue 3, (2017), pp. 419-454. https ://doi.org/10.1007/s11043-016-9336-6.

2016

3. J. Chevalier, **X. P. Morelle**, C. Bailly, P.P. Camanho, T. Pardoen, F. Lani, "Micro-mechanics based pressure dependent failure model for highly cross-linked epoxy resin", *Engineering Fracture Mechanics*, vol. 158, (2016), pp.192-216. https ://doi.org/1016/j.engfracmech.201602.039.

2. V.-D. Nguyen, F. Lani, T. Pardoen, **X. P. Morelle**, L. Noels, "A large strain hyperelastic viscoelastic-viscoplastic-damage constitutive model based on a multi-mechanism non-local damage continuum for amorphous glassy polymers", *International Journal of Solids and Structures*, vol. 96, (2016), pp. 192-216. https ://doi.org/10.1016/j.ijsolstr.2016.06.008.

2015

1. A. Bahrami, **X. P. Morelle**, L. D. Hông Minh, T. Pardoen, C. Bailly, B. Nysten, "Curing dependent spatial heterogeneity of mechanical response in epoxy resins revealed by atomic force microscopy", *Polymer*, vol. 68, (2015), pp. 1-10. https ://doi.org/10.1016/j.polymer.2015.04.084.

Conference publications (with peer-reviewed selection)

10. **X. P. Morelle**, J. Chopin, C. Creton, E. Barthel, M. Ciccotti, "Adhesion on heterogeneous textured surfaces". in 42^{nd} *Annual Adhesion Society Meeting*, Hilton Head, South Carolina, USA, (2019).
9. J. Chevalier, **X. P. Morelle**, P. Camanho, F. Lani, T. Pardoen, "Modelling of an epoxy matrix based on the shear transformation zone framework". in 10^{th} *European Solid Mechanics Conference ESCM2018*, Bologna, Italy, (2018).
8. J. Chevalier, Y.-A. Janssens, **X. P. Morelle**, T. Pardoen, F. Lani, "Characterization and modeling of the transverse compression of RTM-processed thick uni-directional samples". in 17^{th} *European Conference on Composite Materials ECCM17*, Munich, Germany, (2017).
7. F. Lani, **X. P. Morelle**, C. Bailly, T. Pardoen, "Characterization and Modeling of the Strain-Rate, Temperature and Pressure Dependence of the Deformation of a Highly Crosslinked Aerospace Grade Epoxy Resin", in 20^{th} *International Conference on Composite Materials ICCM20*, Copenhagen, Denmark, (2015).
6. J. Chevalier, **X. P. Morelle**, C. Bailly, T. Pardoen, F. Lani, "Micro-Mechanical Modeling of the Pressure Dependent Failure of Highly Crosslinked Epoxy Resin", in 20^{th} *International Conference on Composite Materials ICCM20*, Copenhagen, Denmark, (2015).
5. V.-D. Nguyen, **X. P. Morelle**, F. Lani, T. Pardoen, C. Bailly, L. Noels, "An Elastoplastic-Damage Constitutive Model Based on a Large Strain Hyperelastic Formulation for Amorphous Glassy Polymers", in 20^{th} *International Conference on Composite Materials*, Copenhagen, Denmark, (2015).
4. **X. P. Morelle**, A. Bahrami, F. Lani, M. A. Melchior, B. Nysten, C. Bailly, T. Pardoen, "Characterization and Modeling of the Time-Dependent Behavior of the RTM6 Structural Epoxy Involving Recovery, Creep and Back Stress", in 16^{th} *European Conference on Composite Materials ECCM16* , Seville, Spain, (2014).
3. Y.-A. Janssens, B. Coulon, Q. Voleppe, M. Sclavons, R. Debleser, D. Magnin, W. Ballout, **X. P. Morelle**, F. Lani, C. Bailly, T. Pardoen, "Structural and Micromechanical Characterization and Modeling of the Interdiffusion Region Between Two Thermoset Resins", in 16^{th} *European Conference on Composite Materials ECCM16*, Seville, Spain, (2014).

2. M. A. Melchior, F. Lani, **X. P. Morelle**, L. Brassart, I. Doghri, T. Pardoen, "Non-Linear Micromechanics Based Analysis of a Satin5 Representative Single Ply Volume Element", in 12^{th} *International Conference on Computational Plasticity, Fundamentals and Applications*, Barcelona, Spain, (2013).
1. **X. P. Morelle**, F. Lani, M.A. Melchior, S. André, C. Bailly, T. Pardoen, "The Elasto-Viscoplasticity and Fracture Behavior of the RTM6 Structural Epoxy and Impact on the Response of Woven Composites". in 15^{th} *European Conference on Composite Materials ECCM15*, Venice, Italy, (2012).

Other oral contributions to conferences

9. **X. P. Morelle**, W. R. Illeperuma, R. Bai, K. Tian, Z. Suo, J. J. Vlassak, "Mechanics and fracture of tough hydrogels below water-freezing temperature", in 82^{nd} *Prague Meeting on Macromolecules and* 24^{th} *Polymer Networks Group Meeting, 82PMM & 24PNG*, Prague, Czech Republic, (2018).
8. **X. P. Morelle**, W. R. Illeperuma, R. Bai, K. Tian, Z. Suo, J. J. Vlassak, "Mechanics and fracture of tough hydrogels below water-freezing temperatur", in 16^{th} *European Mechanics of Materials Conference EMMC16*, Nantes, France, (2018).
7. T. Pardoen, **X. P. Morelle**, J. Chevalier, L. Brassart, P. P. Camanho, C. Bailly, F. Lani, "Micromechanics of deformation and fracture in highly cross-linked thermoset", in 16^{th} *European Mechanics of Materials Conference EMMC16*, Nantes, France, (2018).
6. J. Chevalier, **X. P. Morelle**, P. P. Camanho, F. Lani, T. Pardoen, "Characterization and multi-scale modeling of the transverse compression of thick RTM-processed uni-directional samples", in 6^{th} *ECCOMAS Thematic Conference on the Mechanical Response of Composites COMPOSITES 2017*, Eindhoven, The Netherlands, (2017).
5. J. Chevalier, **X. P. Morelle**, P. P. Camanho, T. Pardoen, F. Lani, "Micro-mechanics based pressure dependent failure model for highly cross-linked epoxy resins", in 8^{th} *International Conference on Fracture of Polymers, Composites and Adhesives ESIS TC4*, Les Diablerets, Switzerland, (2017).
4. **X. P. Morelle**, A. Bahrami, F. Lani, B. Nysten, C. Bailly, T. Pardoen, "Characterization and Modeling of the Time-Dependent Behavior of the RTM6 Structural Epoxy Resin Involving Strain Recovery, Creep and Back Stress", in 14^{th} *European Mechanics of Materials Conference EMMC14*, Gothenburg, Sweden, (2014).
3. **X. P. Morelle**, F. Lani, S. André, M. A. Melchior, C. Bailly, T. Pardoen, "The Elasto-Viscoplasticity and Damage Behavior of RTM6 Epoxy Resin", in 8^{th} *European Solid Mechanics Conference ESMC 2012*, Graz, Austria, (2012).
2. **X. P. Morelle**, F. Lani, S. André, M. A. Melchior, C. Bailly, T. Pardoen, "The Elasto-Viscoplasticity and Fracture Behavior of RTM6 Epoxy Resin", in 33^{rd} *SAMPE EUROPE International Technical Conference – SEICO*, Paris, France, (2012).
1. **X. P. Morelle**, S. André, M. A. Melchior, F. Lani, C. Bailly, T. Pardoen, "The Elasto-Viscoplasticity and Fracture Behavior of RTM6 Epoxy Resin", in 10^{th} *Annual SAMPE Benelux Student Meeting*, Ermelo, The Netherlands, (2012).

Grants & Awards

2017-2019 **WBI World Excellence Fellowship**, *provided by Wallonie Bruxelles International*, Bruxelles – Belgium.
Two years grant for pursuing a post-doc research stay in the group of Pr. C. Creton and M. Ciccotti in the SIMM Lab at ESPCI, Paris, France.

2018 **Qualification Maître de Conférences**, *aptitude certification to be an engineering professor in France*, Paris – France.
Obtained in section 28 (Condensed Matter), 33 (Chemistry and Materials Science) and 60 (Mechanics and Civil Engineering), license n°18260319745.

2018 2^{nd} **Best Scientific Picture at 2018 PC-Focus day**, *organized by ESPCI*, Paris – France.
Second prize for the best scientific picture on the theme « *Contraste et Relief* » during the school internal promotion day.

2015-2016 **Cabeaux–Jacobs Fellow**, *provided by B.A.E.F.*, Brussels – Belgium/USA.
One year grant for pursuing a post-doc research stay in the group of Pr. Z. Suo in the School of Engineering and Applied Science at Harvard University, Cambridge, Massachusetts, USA.

2012–2015 **FNRS Research Fellowship**, *provided by F.R.S. (FNRS)*, Bruxelles – Belgium.
Three years PhD Fellowship in the group of Pr. Thomas Pardoen in the Institute of Mechanics, Materials and Civil engineering (iMMC) at UCLouvain.

2012 **Best Presentation at the 10th Annual SAMPE Benelux student meeting**, *organized by SAMPE Benelux*, Ermelo – Netherlands.
Best presentation of Benelux young PhD researchers in the field of aeronautical composites.

2011–2012 **FRIA Research Fellowship**, *provided by F.R.S. (FNRS)*, Bruxelles – Belgium.
One year PhD Fellowship in the group of Pr. Thomas Pardoen the Institute of Mechanics, Materials and Civil engineering (iMMC) at UCLouvain.

2011 **Best Master Thesis Presentation prize**, *organized by AILouvain – Ecole Polytechnique de Louvain – UCLouvain*, Louvain-la-Neuve – Belgium.
Best master thesis presentation (written and oral) of the 2011 EPL engineer promotion.

2010 **AGC Scholarship**, *organized by Ecole Polytechnique de Louvain – UCLouvain*, Louvain-la-Neuve – Belgium.
Sponsored scholarship for 5 months international student exchange at TU/e (Netherlands) with a 2 months internship in AGC research center (Belgium).

Languages

French **Native language**.

English **Fluent**.

Spanish **Fluent**.

Post-graduate training

2018 **Summer school in MEchanics and PHysics of STretchable Objects (MEPHISTO)**, *Cargese, Corsica – France*, August 7 -17 2018.

2013 **Post-graduate course on Advanced Continuum Mechanics**, *organized by GraSMech*, Louvain-la-Neuve – Belgium, november-december 2013.

2012 **Post-graduate course on Multiscale and Micromechanics**, *organized by Engineering Mechanics*, Eindhoven – Netherlands, 6–8 and 13–15 Nov. 2012.

Services

2016–2017 **Lab Safety officer and Equipment trainer**, *Suo Lab – Harvard University*, Cambridge, MA – USA.
Emergency lab contact, development of equipment safety procedures, chemical inventory and disposal coordination. Person-in-charge for new training on Instron testing machine and High-Voltage amplifier.

2016 **New Equipment Purchase and Installation**, *Suo Lab – Harvard University*, Cambridge, MA – USA.
Purchase of a universal testing machine with associated load cells and temperature chamber. Coordination of lab duct work and machine installation.

2011–2014 **iMMC PhD promotion day co-organizer**, *Institute of Materials, Mechanics and Civil engineering – UCLouvain*, Louvain-la-Neuve – Belgium.
Lab promotion presentation and visit organized for 2^{nd} year engineering master students.

2008–2011 **Student Representative**, *EPL - UCLouvain*, Louvain-la-Neuve – Belgium.
Involvement within the Applied Physics and Chemistry degree program commission and work with academic authorities. Coordinate and organize examination schedule as well as other extra-academic group activities.

Miscellanous

2017 – now **Member of the board of directors**, *Gravelines U.S. Aviron*, Gravelines – France.
As a trustee, I get involved into the general management, planning and new projects development of Gravelines rowing club. My missions non exhaustively include the organization and participation to international rowing regattas, preparation of the annual general membership meeting, and promotion of the club activities on social networks.

2016–2017 **Board member**, *Harvard-MIT Belgian Society*, Boston, MA – USA.
Organizing social networking events and open debates among the belgian community (and more) in the Boston area, in order to promote Belgian scientific, political or economical personalities and achievements.

2012–now **Rowing athlete**, *RCNSM aviron (Belgium) – Gravelines U.S. aviron (France) – Riverside B.C (USA).*
Training on a daily basis and competing at national (Belgium and French national champs) and international level (Head of the Charles, Canadian Henley, Henley Royal Regatta, Heineken Cup, World Coastal Rowing Championships).

2007–2012 **Rowing Instructor**, *Belgium Royal Rowing Federation*, Seneffe – Belgium.
ADEPS level 1 degree (2007) and level 2 degree (2010). Summer camp instructor and young rowers (12 to 16 years old) and senior rowers (20 to 30 years old) coach.

Professional Social Media

Personal website	https : //xmorelle.github.io/webpage/
Google Scholar profile	https ://scholar.google.fr/citations ?user=ShCxF94AAAAJ&hl=fr
Research Gate profile	https ://www.researchgate.net/profile/Xavier_Morelle
LinkedIn profile	https ://www.linkedin.com/in/xavier-morelle/
ORCID	https ://orcid.org/0000-0001-6508-8945