Dr. Florian Le Goupil

Born on 28/01/85
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20 articles and books (972 citations, h = 14)
1 patent

I have a highly multi-disciplinary and international profile with a strong background in physical chemistry of crystalline and semi-crystalline materials, both organic and inorganic.

I have extended experience over the whole chain of value of materials for energy, from synthesis to device characterisation. I am convinced that only through this combination of skills can we tackle the challenges in chemistry, physics and materials science, that will unlock the way to the sustainable and energy-efficient materials of tomorrow.

To sum-up, I develop new materials for sustainable cooling and energy storage to build a greener future.

EDUCATION

Imperial College London, *London, UK* 2013
PhD in Materials Science

Université de Strasbourg, *Strasbourg, France* 2009
Master's Degree in Materials Science

School of Chemistry, Polymers and Materials Science (ECPM), *Strasbourg, France* 2009
Diplôme d'ingenieur, ranked second

TEACHING ACTIVITIES

Bordeaux INP, *Bordeaux, France* Sept. 2021-August 2023
Temporary Teaching and Research Assistant (ATER)

I have taught **530 hours** of classes, including **38 h of lectures, 64 h of tutorials and 428 h of practical work**. My teaching topics include mechanical properties of polymers, synthesis and structural characterisation of polymers, mechanical engineering, chemical engineering, spectroscopy, IT and literature studies.

Qualified in **sections 33** (22233332166) et **28** (19228332166).

Supervised Interns/students : Nov. 2017-August 2023
-Bachelor / 2 months / 3 students – Axel Denys (LCPO, 2022), Zack Tricket (LCPO, 2022), Jolan Bertrand (LCPO, 2023)
-Master / 2-8 months / 4 students – Francesco Coin (LCPO, 2020), Jean-Baptiste Coste (LCPO, 2022), Inness Josephat Kamugisha (LCPO, 2023), Barbara Isabella Martin Cortes (LCPO, 2023)
-PhD / >36 months / 1 student – Naser Pouriamanesh (LCPO, 2017 – 2021)

RESEARCH ACTIVITIES

Bordeaux INP, *Bordeaux, France* Sept. 2021-August 2023
Temporary Teaching and Research Assistant (ATER)
LCPO Team 2 and 4 collaborations.
Structure/property relationship in bio-based polymers for efficient high-power energy storage.

Université de Bordeaux, *Bordeaux, France* Jan. 2020-August 2021
Post-Doctoral Research Associate
PI: Prof**.** Guillaume Fleury and Prof**.** Georges Hadziioannou
Structural engineering of fluorinated polymers for efficient refrigeration and energy storage.

ELORPrinTec (Adéra)**,** *Bordeaux, France* July 2019-Dec. 2019
Project Manager
Design and fabrication of a fully printed portable and flexible organic solid-state cooling device.

Université de Bordeaux, *Bordeaux, France* July 2017-June 2019
Marie Curie/PRESTIGE Post-Doctoral Research Fellow
PI: Prof**.** Georges Hadziioannou
Synthesis and characterisation of flexible composites based on fluorinated polymers for energy applications (storage, cooling).

Université de Bordeaux, *Bordeaux, France* Nov 2016-June 2017
Post-Doctoral Research Associate
PI: Prof**.** Georges Hadziioannou
Study of the influence of surface modification of inorganic nanoparticles on the properties of composite films.

Imperial College London, *London, UK* Dec 2015-May 2016
Post-Doctoral Research Associate
PI: Prof**.** Natalie Stingelin
Synthesis and characterisation of solution-processable composites and hybrid materials.

Penn State University, *State College PA, USA* Nov 2014-Nov 2015
Royal Society Visiting Scholar
PI: Prof. Clive Randall
Fabrication and characterisation of lead-free multilayer ceramic capacitors for electrocaloric applications.

Imperial College London, *London, UK* Mar 2013-Nov 2015
Post-Doctoral Research Associate
PI: Prof**.** Neil McN. Alford
- ✓ First direct electrocaloric effect (ECE) measurements on numerous lead-free relaxor ferroelectric materials.
- ✓ First experimental proof of high ECE anisotropy.
- ✓ Tuning of morphotropic phase boundary and accompanied ECE enhancement in NBT-based ceramics.
- ✓ Development of theoretical models based on statistical mechanics describing the ECE in relaxor ferroelectrics.
- ✓ EPSRC Pathway to Impact development of a DSC-fixture for ECE and pyroelectric measurements.
- ✓ Established collaborations with research groups in Slovenia, Finland, Poland, USA as well as several in the UK.

National University of Singapore (NUS), *Singapore* July 2010
Visiting Student
PI: Prof. Ramanathan Mahendiran
Dielectric and Ferroelectric characterisation of epitaxial tungsten bronze thin films.

Imperial College London, *London, UK* Sept 2009- Fev 2013
PhD in Materials Science
Supervisors: Prof. Neil McN. Alford and Dr. Anna-Karin Axelsson
"Electrocaloric effect in ferroelectric relaxors: the road to solid-state cooling"

- ✓ Successful development and benchmarking of a direct electrocaloric effect measurement set-up based on a modified-DSC, allowing the acquisition of both thermal and electrical information simultaneously.
- ✓ Direct ECE measurements on normal ferroelectrics, such as barium titanate, but also well-known relaxor ferroelectrics, such as the PMN-PT system, for fundamental understanding of the electrocaloric effect.
- ✓ Solid state synthesis and characterisation of highly anisotropic relaxor ferroelectrics, including Aurivillius Phase and Tungsten Bronze Materials. Synthesis of grain-oriented ceramics by hot-pressing and templated grain-growth.

Massachusetts Institute of Technology (MIT), *Cambridge MA, USA* May–Aug 2009
Visiting Student
Supervisor: Prof. Gareth McKinley
In association with Harvard University and TA Instruments, development and testing of a new opposed-nozzle fixture, which can be mounted onto controlled strain rheometers, for the measurement of the extensional properties of low viscosity liquids. This research led to a poster which won the Award for Best Post-doctoral Poster at the Society of Rheology Annual Meeting held in 2009 in Madison (USA).

Robert Bosch GmbH, *Stuttgart, Germany* Apr–Oct 2008
Intern
Synthesis and characterisation of nanocrystalline oxide ceramics doped with aliovalent-metal-ions.

NXP Semiconductors (former Philips), *Nijmegen, The Netherlands* Sept 07–Feb 08
Intern
Study and optimisation of the removal mechanism of particles on Silicon “wafers”.

Chemistry, Physics and Materials Science Institute (IPCMS), *Strasbourg, France* Oct–Nov 2006
Intern
Synthesis of hybrid lamellar organometallic compounds.

RESEARCH EXPERIENCE AND TECHNICAL SKILLS

Expert	Direct electrocaloric measurements, high and low field dielectric spectroscopy, differential scanning calorimetry (DSC), X-Ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), energy dispersive X-Rays (EDX), UV–visible spectroscopy, dynamic mechanical analysis (DMA), solid state synthesis, solution-processed polymer film fabrication including spin- and blade-coating and screen-printing, tape-casting for MLC fabrication, thermal evaporation of metallic electrodes.
Experienced	Wide Angle X-ray Scattering. Nuclear Magnetic Resonance (NMR). Size-exclusion chromatography (SEC). Pulsed laser deposition (PLD) and ultra-high vacuum (UHV) systems. Hot-pressing. Polyol and hydrothermal synthesis of nanoparticles. Printing of polymers composites and sensors on flexible substrates.

ADDITIONAL SKILLS

Langues : Français (langue maternelle), anglais (bilingue), allemande (compètent), espagnol (compètent)
Logiciels : MS Office, Visual Basic, Origin, LaTex, MathCad, Photoshop

Examinateur pour > 10 journaux scientifiques à haut impact, dont Journal of Materials Chemistry C.

AWARDS AND FUNDING

Royal Academy of Engineering travel grant (£500) et Royal Society of Chemistry travel grant (£800)
Royal Society International Exchange Scheme (£6000)
Marie Curie/PRESTIGE Post-Doctoral Research Fellowship (30000€)

LIST OF PUBLICATIONS

Peer Reviewed Articles (**19 articles, 758 citations, h-index = 14,** average **IF = 7.9**)

19) **F. Le Goupil***, V. Salvado, V. Rothan, T. Vidil, G. Fleury, H. Cramail* and E. Grau*, "Bio-based poly(hydroxy urethane)s for efficient organic high-power energy storage", *Journal of the American Chemical Society* 145, 8, 4583–4588 (2023). **IF = 16.4**
https://doi.org/10.1021/jacs.2c12090

18) **F. Le Goupil***, G. Payrot*, et al.* and G. Hadziioannou*, "Fully printed sensors for in-situ temperature, heat flow and thermal conductivity measurements in flexible devices.", *ACS Omega* 8, 9, 8481–8487 (2023). **IF = 4.1**
https://doi.org/10.1021/acsomega.2c07590

17) N. María, **F. Le Goupil**, *et al.*, J. Maiz*, and A. Müller* "Effect of the TrFE Content on the Crystallization and SSA Thermal Fractionation of P(VDF-co-TrFE) Copolymers.", *International Journal of Molecular Sciences* 23, 10365 (2022). **IF = 6.2**
https://doi.org/10.3390/ijms231810365

16) N. Pouriamanesh**, F. Le Goupil**, N. Stingelin*, and G. Hadziioannou*, "Limiting Relative Permittivity "Burn-in" in Polymer Ferroelectrics via Phase Stabilization", *ACS Macro Letters* 11, 410-414 (2022). **IF = 7**
https://doi.org/10.1021/acsmacrolett.2c00022

15) **F. Le Goupil***, F. Coin, *et al.*, "Electrocaloric Enhancement Induced by Cocrystallization of Vinylidene Difluoride-Based Polymer Blends", *ACS Macro Letters* 10, 12, 1555-1562 (2021). **IF = 7**
https://doi.org/10.1021/acsmacrolett.1c00576

14) **F. Le Goupil**, *et al.* and G. Hadziioannou*, "Enhanced Electrocaloric Response of Vinylidene Fluoride–Based Polymers via One-Step Molecular Engineering", *Advanced Functional Materials* 31, 1, 2007043 (2021). **IF = 19.9**
https://doi.org/10.1002/adfm.202007043

13) **F. Le Goupil***, A. Baker, F. Tonus*, et al.*, "Direct measurement of electrocaloric effect in lead-free (Na0. 5Bi0. 5) TiO3-based multilayer ceramic capacitors", *Journal of the European Ceramic Society* 39, 11, 3315-3319 (2019). **IF = 5.3**
https://doi.org/10.1016/j.jeurceramsoc.2019.04.032

12) A-K. Axelsson*, **F. Le Goupil**, M. Valant, N. M. Alford, "Optimisation of $SrBi_2(Nb,Ta)_2O_9$ Aurivillius phase for lead-free electrocaloric cooling", *Journal of the European Ceramic Society* 38, 16, 5354-5358 (2018). **IF = 5.3**
https://doi.org/10.1016/j.jeurceramsoc.2018.07.044

11) C. Molin*, J. Peräntie, **F. Le Goupil**, *et al.*, "Comparison of Direct Electrocaloric Characterization Exemplified by 0.92 Pb(Mg1/3Nb2/3)O3 - 0.08 PbTiO3 Multilayer Ceramics", *J. American Ceramic Society* 100, 7, 2885-2892 (2017). **IF = 4.2**
https://doi.org/10.1111/jace.14805

10) A-K. Axelsson*, **F. Le Goupil**, M. Valant, *et al.*, "Electrocaloric effect in lead-free Aurivillus relaxor ferroelectric ceramics", *Acta Materialia* 124, 120-126 (2017). **IF = 9.2**
https://doi.org/10.1016/j.actamat.2016.11.001

9) **F. Le Goupil***, R. McKinnon, V. Koval, G. Viola, S. Dunn, *et al.*, "Tuning the electrocaloric enhancement near the morphotropic phase boundary in lead-free ceramics", *Scientific Reports* 6, 28251 (2016). **IF = 5**
https://doi.org/10.1038/srep28251

8) A. Berenov*, **F. Le Goupil**, and N. McN. Alford, "Effect of ionic radii on the Curie temperature in Ba1-x-ySrxCayTiO3 compounds", *Scientific Reports* 6, 28055 (2016). **IF = 5**
https://doi.org/10.1038/srep28055

7) **F. Le Goupil*** and N. M. Alford, "Upper limit of the electrocaloric peak in lead-free ferroelectric relaxor ceramics", *APL Materials* 4, 064104 (2016). **IF = 6.6**

https://doi.org/10.1063/1.4950790

6) **F. Le Goupil***, J. Bennett, A-K. Axelsson, *et al.*, "Electrocaloric enhancement near the morphotropic phase boundary in lead-free NBT-KBT ceramics", *Applied Physics Letters* 107, 172903 (2015). **IF = 4**
https://doi.org/10.1063/1.4934759

5) **F. Le Goupil***, A-K. Axelsson, M. Valant, *et al.*, "Effect of Ce doping on the electrocaloric effect of SrxBa1xNb2O6 single crystals", *Applied Physics Letters* 104, 222911 (2014). **IF = 4**
https://doi.org/10.1063/1.4881842

4) **F. Le Goupil***, A-K. Axelsson, L. J. Dunne, *et al.*, "Anisotropy of the Electrocaloric Effect in Lead-Free Relaxor Ferroelectrics", *Advanced Energy Materials* 4, 1301688 (2014). **IF = 29.7**
https://doi.org/10.1002/aenm.201301688

3) A-K. Axelsson*, **F. Le Goupil**, *et al.*, "Microscopic interpretation of sign reversal in the electrocaloric effect in a ferroelectric PbMg1/3Nb2/3O3-30PbTiO3 single crystal", *Applied Physics Letters* 102, 102902 (2013). **IF = 4**
https://doi.org/10.1063/1.4794543

2) M. Valant*, A-K. Axelsson, **F. Le Goupil**, N. M. Alford, "Electrocaloric temperature change constrained by the dielectric strength", *Materials Chemistry and Physics* 136, 277-280 (2012). **IF = 4.1**
https://doi.org/10.1016/j.matchemphys.2012.08.059

1) **F. Le Goupil***, A. Berenov, A-K. Axelsson, *et al.*, "Direct and Indirect Electrocaloric Measurements on <001>-$PbMg_{1/3}Nb_{2/3}O_3$-30$PbTiO_3$ Single Crystals", *Journal of Applied Physics* 111 (2012) 124109. **IF = 2.9**
https://doi.org/10.1063/1.4730338

Book (**214 citations**)

Anna-Karin Axelsson, Matjaz Valant, **Florian Le Goupil**, Andrey Berenov, Neil McN. Alford "Chapter 6: Electrocaloric Bulk Materials: towards lead-free cooling electrocaloric materials" in *Electrocaloric Materials: New Generation of Coolers.* Editors T. Correia, Q. Zhang, Eds Springer (2013)
https://doi.org/10.1007/978-3-642-40264-7_6

Patents

Fabrice Domingues Dos Santos, Thibaut Soulestin, **Florian Le Goupil**, Konstantinos Kallitsis, Georges Hadziioannou "Electrocaloric polymer, ink and film comprising the same and uses thereof" FR3104583B1 (2022), US Patent App. 17/784,438 (2023)
https://patents.google.com/patent/FR3104583B1/

Key Conference Contributions

Invited Oral Presentations:

3) **Florian Le Goupil**, Andrey Berenov, Neil McN. Alford "Enhanced Electrocaloric Effect in Lead-Free Ceramics with Critical Points." Winton Meeting on Caloric Materials, February 2016, Cambridge, UK.

2) **Florian Le Goupil**, Anna-Karin Axelsson "Novel Solid State Coolers - Electrocalorics", SIRACH Networking meeting on Domestic and Commercial Heating and Cooling, January 2016, Woking, UK.

1) **Florian Le Goupil**, Neil McN. Alford "Enhanced Electrocaloric Effect in Lead-Free Ceramics with Critical Points" June 2015, University of Nova Gorica, Nova Gorica, Slovenia.

Oral Presentations:

9) **Florian Le Goupil**, *et al.* "Electrocaloric Enhancement Induced by Cocrystallization of Vinylidene Difluoride-Based Polymer Blends." ISAF-PFM-ECAPD 2022, June 2022, Tours, France.

8) **Florian Le Goupil**, *et al.* "Bio-based poly(hydroxy urethane)s for efficient organic high-power energy storage." Groupe Français des Polymères 2021, GFP 2021, October 2021, Lyon, France.

7) **Florian Le Goupil**, *et al.* "All organic multilayer polymer systems for efficient energy storage." European Polymer Congress 2019, EPF 2019, June 2019, Hersonissos Heraklion, Greece.

6) **Florian Le Goupil**, *et al.* "Electrocaloric effect in fluorinated polymer nanocomposites with various lead-free inorganic nanoparticles." ISAF-FMA-AMF-AMEC-PFM 2018, Mai 2018, Hiroshima, Japon.

5) **Florian Le Goupil**, *et al.* "Efficient electrocaloric cooling through polymer nanocomposites with high dielectric strength." ISAF-IWATMD-PFM 2017, Mai 2017, Georgia Institute of Technology, Atlanta, GA, USA.

4) **Florian Le Goupil**, *et al.* "Anisotropy of the Electrocaloric Effect in Lead-Free Relaxors." ISAF-IWATMD-PFM 2014, Mai 2014, Penn State University, State College, PA, USA.

3) **Florian Le Goupil**, *et al.* "Novel Lead-Free Relaxor Ferroelectrics for Electrocaloric Cooling." ECo MaTech 2013, September 2013, Bled, Slovenia.

2) **Florian Le Goupil**, *et al.* "Anisotropy of the Electrocaloric Effect by Direct Measurements" ISAF-ECAPD-PFM 2012, July 2012, Aveiro, Portugal.

1) **Florian Le Goupil**, *et al.* "Direct electrocaloric measurements in polar materials" ISAF-PFM 2011, 24-27 July 2011, Vancouver, Canada.

Posters:

4) **Florian Le Goupil**, *et al.* "Bio-based poly(hydroxy urethane)s for efficient organic high-power energy storage." Bordeaux Polymer Conference BPC 2022, June 2022, Bordeaux, France.

3) **Florian Le Goupil**, *et al.* "Enhanced Electrocaloric Effect in Novel Lead-Free Relaxor Ferroelectrics." ISAF-UFFC 2013, July 2013, Prague, Czech Republic.

2) **Florian Le Goupil**, *et al.* "Electrocaloric effect studied across a field-induced phase transition by direct and indirect measurements" 2nd TYC Energy Materials Workshop and Tutorial, June 2012, London, UK.

1) **Florian Le Goupil**, *et al.* "Anisotropy of the Electrocaloric Effect by Direct Measurements" MRS Spring Meeting 2012, April 2012, San Francisco, USA.