

Curriculum Vitae of Dr. Colin Bonduelle

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25/02/1980, French Citizen (2 children)

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Experience

- January 2019- **CNRS researcher** at the "Laboratoire de Chimie des Polymères Organiques" (joint research unit 5629 Université de Bordeaux/CNRS/IPB, director Pr. Sébastien Lecommandoux) to develop new ring-opening methodologies to access synthetic polypeptide polymers in the team "Polymer self-assembly and Life Sciences".
- 2014-2018 **CNRS researcher** at "Laboratoire de Chimie de Coordination", directed by Dr. Azzedine Bousseksou (formerly called LCC, autonomous CNRS research unit UPR8241). Main topic: Secondary structures of synthetic polypeptide polymers.
- 2011-2013 **Postdoctoral fellowship** funded by the CNRS in Pr. Sébastien Lecommandoux's group at the University of Bordeaux (LCPO). Main topic: Synthesis and self-assembly of amphiphilic glycopolymers.
- 2009-2010 **Postdoctoral fellowship** funded by LANXESS in Pr. Elizabeth Gillies' group at Western University (Department of Chemistry, London, Ontario, Canada) in collaboration with Pr. Leo Lau from the Surface Science department (Faculty of Engineering, London, Ontario, Canada). Main topic: Grafting and macromolecular engineering of PEO.

Education

- Nov. 2018 **Habilitation thesis** of the University of Toulouse entitled "Synthetic polypeptide polymers as simplified analogues of natural proteins" (defended publicly on 16/11/2018).
- 2005 – 2009 **PhD (Doctorat)** of the University of Toulouse in Macromolecular Chemistry supervised by Dr. Didier Bourissou at Laboratoire de Chimie Fondamentale et Appliquée (joint unit 5069, CNRS) on "Ring-Opening Polymerization of activated analogues of Lactones".
- 2004-2005 **M.Sc. in Chemical Biology (M2R)** at the University of Toulouse obtained with the highest grade (1st rank of promotion). M.Sc. thesis at LCC supervised by Dr. Bernard Meunier on the design of antimalarial drugs.

Research grants

- 2020 **UBx funding** (coPI with Pr. Sébastien Lecommandoux): Development Engineer (6 months) on Ring-Opening Polymerization-Induced Self-Assembly (50 k€).
- 2020-2024 **ECOS funding** (UNAM- University of Bordeaux): Travel exchanges with Mexico to support the project POLYMERZYME (enzyme like catalysis with polypeptides, about 20 k€)
- 2019 **MRSEI ANR funding** (coPI with Pr. Sébastien Lecommandoux): Travel exchanges and financial support for an ITN application (PEPTIMPULSE, about 30 k€)
- 2017 **Conacyt PhD funding**: Mexican PhD fellowship on "antimicrobial polypeptoid polymers" co-directed with Pr. Pierre Verhaeghe (LCC, Toulouse).
- 2017 **Occitanie Region PhD funding**: PhD fellowship on "Self-assembly by coordination of peptidic homopolymers" co-directed with Dr. Simon Tricard (LPCNO, Toulouse).
- 2017-2021 **ANR THERAPEPTICS** (co-PI with Pr. Pierre Verhaeghe, 220 k€): ANR project focusing on antimicrobial polymers. PhD fellowship (co-direction with Pr. Pierre Verhaeghe).
- 2016 **Occitanie Region Post-doc funding**: Post-doc fellowship on "metal induced structuring of polypeptide polymers" (NANOPELIX project, about 60 k€)

Comitments

Seminar officer at the LCPO (since 2019, organization of weekly internal seminars as well as annual programming of external seminars). **Teaching** at the IPB of Bordeaux: Master 2 course "Polymer and sustainable development" (2019, 2h). **Partner Member of the LIA** "Laboratoire de Chimie Moléculaire

avec applications dans les Matériaux et la Catalyse" (LCMMC, France/Mexico). Collaborative effort with the UNAM, Mexico City, Mexico (2018-2022). Member of the **GFP National Meeting Steering Committee** (Toulouse, November 2018). **Teaching** at the Faculty of Pharmacy of Toulouse: Master 1 course "initiation to peptide synthesis" (2015-2018, 6h/year). Elected **member of the LCC laboratory Council** (2015-2018).

General profile

Dr. Colin Bonduelle graduated with a PhD from the University of Toulouse, France, in December 2008. Supervised by Dr. Didier Bourrissou (France, LHFA, UMR CNRS 5069), his thesis dissertation addressed preparation of polyesters from O-carboxyanhydrides. For his first post-doctoral experience, he spent two years at Western University (Department of chemistry, Ontario, Canada) studying block copolymer patterning in surface science under the supervision of Pr. Elizabeth Gillies. He then moved in 2011 to LCPO to work with Pr. Sébastien Lecommandoux on the design of new biocompatible amphiphilic copolymer self-assemblies. In October 2014, he was appointed as a tenured CNRS researcher working in the Laboratoire de Chimie de Coordination (LCC UPR8241, Toulouse, France) in the team "Molecular and macromolecular anti-infectious agents" headed by Pr. Pierre Verhaeghe. Since January 2019, Dr. Colin Bonduelle rejoined the team of Sébastien Lecommandoux at the LCPO. His current research is dedicated to the design of macromolecular peptidomimetics using ring-opening polymerization.

39 peer-reviewed articles in journals, 3 patents

Total number of citations > 1200, h-index = 18 (source = ISI Web of Knowledge)

13 publications in the reference period (2016-2020, 9 corresponding author including 2 Chem. Commun, 1 Nature Commun. and 1 Angew. Chem. Int. Ed.), 6 talks in international conferences (3 invited communications), 13 invited seminars in other institutions (7 international), 9 oral/posters.

1. "Multivalent effect of glycopolyptide based nanoparticles for galectin binding" Colin Bonduelle*, Hugo Oliveira, Cony Gauche, Jin Huang, Andreas Heise, Sébastien Lecommandoux*, **Chem. Commun.** 2016, 52, 11251.
2. "Smart metallopoly(glutamic) polymers: reversible helix-to-coil transition at neutral pH" Colin Bonduelle*, Fatma Makni, Laura Severac, Estefania Piedra-Arroni, Charles-Louis Serpentine, Sébastien Lecommandoux, Geneviève Pratviel **RSC Advances**. 2016, 6, 84694.
3. "Synthesis of asymmetric guanidiniumphenyl-aminophenyl porphyrins" Arnaud Perrier, Emmanuelle Mothes, Colin Bonduelle, Geneviève Pratviel **J. Porphyrins Phtalocyanines** 2016, 20, 1438.
4. "Nucleopolyptides with DNA-triggered α helix-to- β sheet transition" Michel Nguyen, Jean-Luc Stigliani, Geneviève Pratviel, Colin Bonduelle* **Chem. Commun.**, 2017, 53, 7501.
5. "Smart Poly(imidazolyl-L-lysine): Synthesis and Reversible Helix-to-Coil Transition at Neutral pH" Estefania Piedra-Arroni, Fatma Makni, Laura Severac, Jean-Luc Stigliani, Geneviève Pratviel, Colin Bonduelle* **Polymers**, 2017, 276, 1-7.
6. "Secondary structures of synthetic polypeptide polymers" Colin Bonduelle* **Polym. Chem.**, 2018, 9, 1517.
7. " Cd^{2+} coordination: an efficient structuring switch for polypeptide polymers" Julien Aujard-Catot, Michel Nguyen, Christian Bijani, Geneviève Pratviel, Colin Bonduelle* **Polym. Chem.**, 2018, 9, 4100. (Cover).
8. "Ionic polypeptide polymers with unusual β -sheet stability" Michel Nguyen, Jean-Luc Stigliani, Christian Bijani, Pierre Verhaeghe, Geneviève Pratviel, Colin Bonduelle* **Biomacromolecules**, 2018, 19, 4068.
9. "Antitrypanosomal pharmacomodulation at position 3 of the 8-nitroquinolin-2(1H)-one scaffold using pallado-catalyzed cross coupling reactions" Julien Pedron, Clotilde Boudot, Sandra Bourgeade-Delmas, Alix Sournia-Saquet, Lucie Paloque, Maryam Rastegari, Mansour Abdoulaye, Hussein El-Kashef, Colin Bonduelle, Geneviève Pratviel, Susan Wyllie, Alan Fairlamb, Bertrand Courtioux, Pierre Verhaeghe and Alexis Valentin **ChemMedChem**, 2018, 13, 2217.
10. "Combination of photodynamic therapy and gene silencing achieved through the hierarchical self-assembly of porphyrin-siRNA complexes" Nabila Laroui, Maeva Coste, Laure Lichon, Yannick Bessin, Magali Gary-Bobo, Geneviève Pratviel, Colin Bonduelle, Nadir Bettache, Sebastien Ulrich, **Int. J. Pharm.** 2019, 569:118585.
11. "Synthesis of nanomolar active antikinoplastid compounds, bioactivated by type I nitroreductases, in 6-substituted-8-nitroquinolin-2(1H)-ones series" Julien Pedron, Clotilde Boudot, Sandra Bourgeade-Delmas, Alix Sournia-Saquet, Elisa Boutet-Robinet, Lucie Paloque, Colin Bonduelle, Geneviève Pratviel, Sophie Corvaisier, Marc Since, Aurélie Malzert-Fréon, Susan Wyllie, Alan H. Fairlamb, Bertrand Courtioux, Alexis Valentin and Pierre Verhaeghe **ACS Med. Chem. Lett.**, 2020, 11, 4, 464-472.
12. "Aqueous Ring-Opening Polymerization-Induced Self-Assembly (ROPISA) of N-carboxyanhydrides" Chloe Gazon, Pedro Salas-Ambrosio, Emmanuel Ibarboure, Alix Buol, Elisabeth Garanger, Mark Grinstaff, Sebastien Lecommandoux,* Colin Bonduelle* **Angew. Chem. Int. Ed.**, 2020, 59, 622. (VIP Paper/Cover).

13. "*Bidimensional lamellar assembly by coordination of peptidic homopolymers to platinum nanoparticles*" Ghada Manai, Hend Houmel, Mathilde Rigoulet, Angélique Gillet, Pier-Francesco Fazzini, Alfonso Ibarra, Stéphanie Balor, Pierre Roblin, Jerome Esvan, Yannick Coppel, Bruno Chaudret, Colin Bonduelle*, Simon Tricard* **Nature Commun.** 2020, in press (doi.org/10.1038/s41467-020-15810-y)

Oral communication

1. *Synthetic polypeptides as biomimetic analogues of natural proteins (invited)*, JEPO congress of 2016, Piriac sur Mer, France (September 21, 2016).
2. *Synthetic polypeptides as simplified analogues of conjugated proteins (invited)*, 8th International Symposium on Polymer Chemistry, PC2018, Changchun, China (June 6-9, 2018).
3. *Smart Nucleopolymer polymers*, 257th ACS national meeting (Chemistry for New Frontiers), PMSE, Orlando, USA (March 31- April 4, 2019).
4. *Metal coordination: and efficient structuring switch for polypeptide polymers*, 257th ACS national meeting (Chemistry for New Frontiers), POLY, Orlando, USA (March 31- April 4, 2019).
5. *Synthetic polypeptide polymers as simplified analogues of conjugated proteins*, 258th ACS national meeting (Chemistry and Water), PMSE, San Diego, USA (August 25- 29, 2019).
6. *Synthetic polypeptides polymers: secondary structures and self-assembly (invited)* International Conference on Polymers and Adv. Materials, POLYMAT-2019, Huatulco, Mexico (October 20-25, 2019).

Invited seminars

1. *Synthetic polypeptides as biomimetic analogues of natural proteins*. Invited seminary session in the laboratory **LPCNO** (UMR 5215), Toulouse, France (March 17, 2016).
2. *Synthetic polypeptides as biomimetic analogues of natural proteins*. Invited seminary session in the laboratory **IMRCP** (UMR 5623), Toulouse, France (October 17, 2016).
3. *Smart metallopolypeptides as biomimetic analogues of metalloproteins*. Invited seminary session in "**Centro de Nanociencias y Nanotecnología**", UNAM, Ensenada, Mexico (December 13, 2016).
4. *Multivalent effect of glycopolypeptide based nanoparticles*. Invited seminary session in "**Centro de Nanociencias y Nanotecnología**", UNAM, Ensenada, Mexico (December 14, 2016).
5. *Synthetic polypeptides as biomimetic analogues of natural proteins*. Invited seminary session in "**Instituto de Investigaciones en Materiales**", UNAM, Mexico City, Mexico (December 16, 2016).
6. *Synthetic polypeptides as biomimetic analogues of natural proteins*. Invited seminary session in "**Institut Charles Sadron**", Strasbourg, France (March 21, 2017).
7. *Synthetic polypeptides as simplified analogues of smart protein systems*. Invited seminary session in "**Institut Européen de Chimie et Biologie**", Bordeaux, France (June 15, 2017).
8. *Synthetic polypeptides polymers as simplified analogues of conjugated proteins*. Invited seminary session in the laboratory **IPREM** (UMR 5254), Pau, France (November 22, 2018).
9. *Synthetic polypeptides polymers as simplified analogues of proteins*. Invited seminary session in "**Facultad de Química**", UNAM, Mexico city, Mexico (November 30, 2018).
10. *DNA and metal-responsive polypeptide polymers*. Invited seminary session in "**Instituto de Investigaciones en Materiales**", UNAM, Mexico city, Mexico (January 8, 2019).
11. *Stimuli-responsive structuring in polypeptide polymers*. Invited seminary session in **Unité Matériaux et Transformations (UMET)**, Lille, France (April 9, 2019).
12. *Aqueous Ring-Opening Polymerization-Induced Self-Assembly (ROPISA) of N-carboxyanhydrides*. Invited seminary session in "**Facultad de Química**", UNAM, Mexico city, Mexico (October 31, 2019).
13. *Secondary structuring in polypeptide polymers*. Invited seminary session in **ETH Zurich**, Department of Mechanical and Process Engineering, Zurich, Switzerland (November 21, 2019).

Peer reviewing in the period 2016-2020 for international journals

(x revisions): ACS Appl. Mater. Inter. (2), ACS Macro Lett. (2), Angew. Chem. Int. Ed. (2), Biomacromolecules (16), Chem. Soc. Rev. (2), J. Am. Chem. Soc. (2), Macromolecules (4), Polym. Chem. (4), etc... My expertise has led me to appraise national and international calls and in particular research project for CONACYT, the national research agency in Mexico. To better interact with this country, since 2018, I am a member of the France-Mexico Associated International Laboratory (LCMMC) to develop a collaborative research activity with the UNAM in Mexico City to develop artificial enzymes based on polypeptides (POLYMERZYME Project). Since 2016, I was also solicited as reviewer of research proposals by the French Technological National Research Agency (ANRT), by the COFECUB international council and by the MSC-IF call (H2020). **As part of my expertise, I have also taught a few hours of master's level courses on peptide synthesis (6h/year) and on the theme of polymers and sustainable development (2h).** At last, whether at the LCC or at the LCPO since 2019, I am involved in the life of my laboratory, having been a member of the laboratory council or now in charge of seminars (internal and external to the LCPO).

Supervision of students: including 3 PhDs under supervision.

2016: Fatma Makni, Master II internship (6 months). Hend Houimel, Master II internship (6 months). Michel N'Guyen, post-doctoral fellow (1 year).

2017: Adrien Schahl, Master II internship (6 months). Julien Aujard Catot, Master I internship (2 months). Ghada Manai, PhD student (co-supervision 2017-2020). Pedro Salas Ambrosio, PhD Student, (supervision 2017-2020).

2018: Antoine Tronnet, Master II internship (6 months). Xuming Zhang, IUT intership (2 months). Antoine Tronnet, PhD student (co-supervision 2018-2021).

2019: Vanita Khanna, Master I internship (2 months), Alix Buol, Master I internship (1 month), Paul Klemm (PhD secondment, 3 months).

2020: Roudaina Lebdi, Master II internship (6 months). Boris Bizet, development engineer (in progress).

Research and main ongoing projects

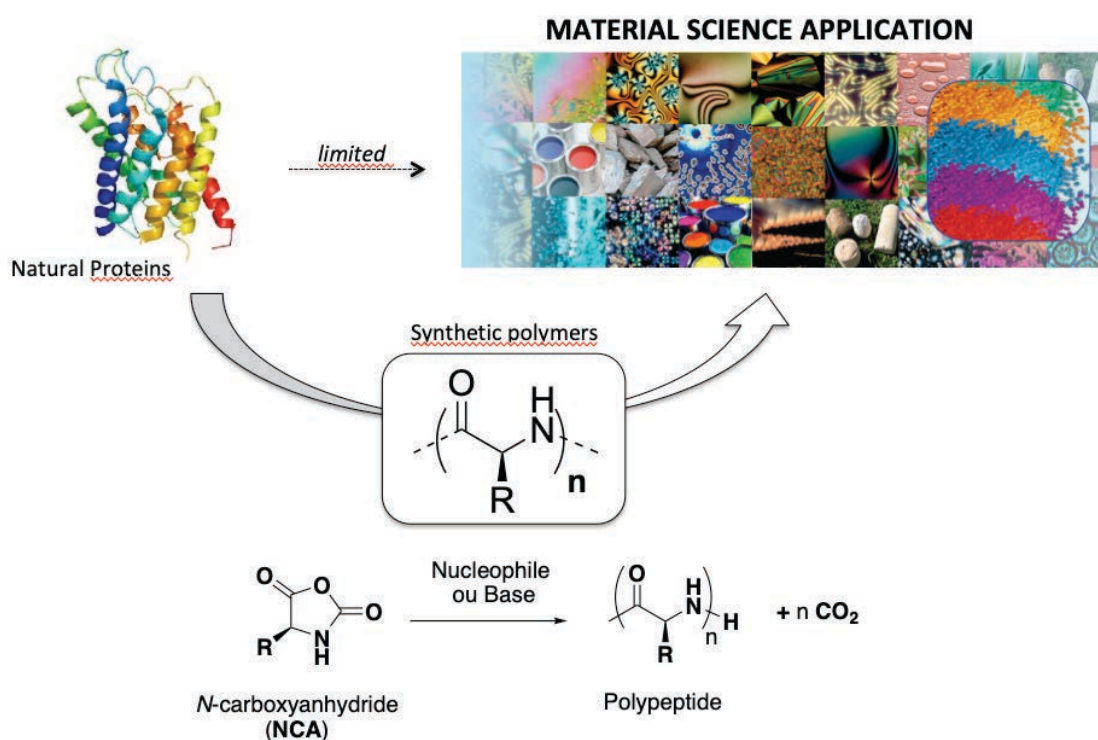


Figure 1. Synthetic polypeptides made by ring-opening polymerization as simplified analogues of natural proteins for material science application

Since joining the CNRS in 2014, I have worked in different research areas at the interface of chemistry and biology, most of them related to polymer chemistry. One of my favorite tools in chemistry is ring-opening polymerization (ROP) to prepare peptide-based synthetic polymers. I can summarize my scientific process as a “**bio-simplification approach**” that aims at 1) better understanding the physico-chemical and biological properties of natural proteins; 2) extracting fundamental principles from these properties and 3) making these principles useful for industrial applications (see Figure 1). **Synthetic polypeptides can be seen as simplified protein analogues:** they are ideal building-blocks to design protein mimics for materials science applications. In particular, polypeptides can adopt natural protein secondary structures such as α -helices or β -sheets; this unique feature is at the origin of their fascinating properties.¹

In recent years (2016-2020), my main research interest has been to use polymer chemistry and the secondary structure of polypeptides to build simplified models of metalloproteins and nucleoproteins. First, as a research scientist at the Laboratoire de Chimie de Coordination in

Toulouse, I aimed to prepare metallopolypeptide or nucleopolypeptide polymers.² Using reversible interactions based on coordination chemistry or on DNA binding, I developed synthetic polymer backbones that behave as stimuli-responsive systems. Such polypeptides are currently supporting a collaborative effort with the LPCNO (Ghada Manai PhD project underprogress) to prepare new classes of bioinspired piezoelectric nanocomposites.³ A second research topic initiated at the LCC is the preparation of novel polypeptide polymers to mimic antimicrobial peptides. The idea of this project is 1) to simplify the structure of antimicrobial peptides using a copolymerization methodology and 2) to reproduce the essential chemical properties responsible for antimicrobial activity. This project currently involves two PhD students (Pedro Salas Ambrosio and Antoine Tronnet, PhD projects underprogress) in collaboration with the Institut Pasteur in Paris.

My geographical mobility from Toulouse to Bordeaux coincides with an intensification of my research towards the development of new methodologies using ring-opening polymerization. This year I reported the first example of Ring-Opening Polymerization Induced Self-Assembly (ROPISA, Figure 2).³ Conventionally, water must be strictly absent from the ROP medium to avoid NCA hydrolysis and water-induced polymerization. In this work we found a way to suppress water-induced NCA polymerization and simultaneously formed original needle-like nano-objects (Figure 2).

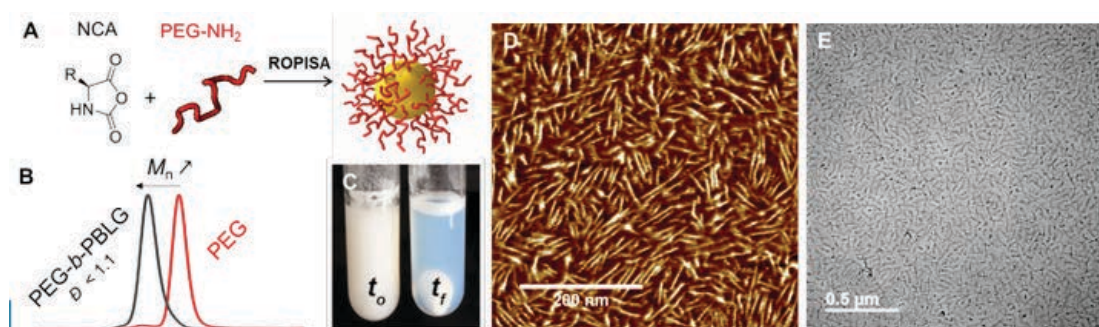


Fig. 2. ROPISA of N-carboxyanhydride (A) affords controlled ROP (B) and original nano-objects (C-E)

My current and future projects address fundamental issues dealing with ring-opening polymerization. Synthetic peptide-based polymers represent a unique class of materials to mimic the properties of natural proteins and they can be obtained in large scale using ROP. I strongly believe that polypeptide polymers are the building blocks of the innovative materials of the future, and that only the ring-opening (co)polymerization of NCAs has the potential to deliver advanced protein-like macromolecules in sufficient quantity for materials applications.

References

1. C. Bonduelle* **Polym. Chem.**, 2018, 9, 1517.
2. a) M. Nguyen, J.L. Stigliani, G. Pratviel, C. Bonduelle* **Chem. Commun.**, 2017, 53, 7501. b) M. Nguyen, J.L. Stigliani, C. Bijani, P. Verhaeghe, G. Pratviel, C. Bonduelle* **Biomacromolecules**, 2018, 19, 4068. c) b) J. Aujard-Catot, M. Nguyen, C. Bijani, G. Pratviel, C. Bonduelle* **Polym. Chem.**, 2018, 9, 4100. (Cover Art).
3. G. Manai, H. Houimel, M. Rigoulet, A. Gillet, P.F. Fazzini, A. Ibarra, S. Balor, P. Roblin, J. Esvan, Y. Coppel, B. Chaudret, C. Bonduelle*, S. Tricard* **Nature Commun.** 2020, *in press* (doi.org/10.1038/s41467-020-15810-y)
4. C. Gazon, P. Salas-Ambrosio, E. Ibarboure, A. Buol, E. Garanger, M. Grinstaff, S. Lecommandoux,* C. Bonduelle* **Angew. Chem. Int. Ed.**, 2020, 59, 622. (VIP Paper/Cover).