Patrice Rannou

CNRS's Director of Research (DR-CNRS)

UMR5819-LEPMI (CEA/Grenoble-INP/UGA/USMB):
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a) Professional Preparation:

Institut Textile & Chimique de Lyon (ITECH)	Macromolecular Chemistry	M.Sc. 1993
Ecole Nationale Supérieure de Chimie de Montpellier (ENSCM)	Polymer Science	M.Sc. 1994
University Montpellier II (UMII)	Polymer Physics	M.Sc. 1994
University Joseph FOURIER-Grenoble I (UJF)	Physics	Ph.D. 1998
University of Grenoble (UG)	Chemistry Research Habilitation	HDR 2013

b) Appointments:

10/99-present **CR2** (10/99⇨10/02) Chargé de Recherche 2ème classe CNRS (*CR2 is eq. to a position of Assistant Professor*), then **CR1** (10/02⇨03/15) Chargé de Recherche 1ère classe CNRS (*CR1 is eq. to a position of Associate Professor*), and currently **DR2** (10/15⇨present) Directeur de Recherche 2ème classe CNRS (*DR2 is eq. to a position of Full Professor*) at the Institute of Chemistry (INC). Sec. 11.
Laboratory: UMR5279-LEPMI (CEA/Grenoble-INP/UGA/USMB)

09/13-12/17 Deputy Head (09/13⇨09/17) & Director (09/17⇨01/18) of the Observatory of Micro and NanoTechnologies UMS2920-OMNT (CEA/CNRS): A joint CEA+CNRS service unit performing strategic watches and establishing scientific strategies for CEA & CNRS into the fields of Micro/Nano-Technologies

06/98-09/99 Visiting Researcher, New Materials Lab. R&D Center, Hitachi Chemical. Co. Ltd, Japan

c) Short Biosketch: Dr. Patrice Rannou (ORC**ID:** 0000-0001-9376-7136) graduated from the Textile & Chemical Institute of Lyon (1993/M.Sc. in Polymer Chemistry) and from University Montpellier II (1994/M.Sc. in Polymer Physics) and E.N.S. de Chimie de Montpellier (1994/M.Sc. in Polymer Science). He holds a PhD in Physics from the University J. Fourier (1998) and a research habilitation (HDR) in Chemistry (2013) from the University of Grenoble. After 16 months spent as a visiting researcher at the R & D New Materials Center of Hitachi Chemical Co. Ltd (HCC) in Hitachi-city, Japan, he was hired in Oct. 1999 as a CNRS researcher in the UMR5819-**SyMMES** (**M**olecular **Sy**stems & nano**M**aterial**S** for **E**nergy & health) lab where he served till Sept. 30, 2021. Since Oct. 2021, he is a CNRS member of the **MIEL** Team (**M**aterials, **I**nterfaces and **EL**ectrochemistry) of the UMR5279-**LEPMI** (**L**aboratory of **E**lectrochemistry and **P**hysicochemistry of **M**aterials & **I**nterfaces) lab. He holds a CNRS Director of Research position within the section 11 (Supra/Macro-Molecular Systems & Materials: Elaboration, Properties, & Functions) of **CNRS-INC** (CNRS's National Institute of Chemistry) since Oct. 2015. Till date (*i.e.* March. 2022), he has (co)advised **17** postdoctoral fellows, (co)supervised **11** PhD students and **>35** (under)graduate students. He is the (co)authors of **134** papers (**77** regular articles and **57** proceeding papers), **2** book chapters, and **16** (FR/EP/JP/US/WO) patents.

d) Research Overview: *In a nutshell*, *multi-scale structures/property (electronic, ionic, protonic transfers) correlations within self-assembled and hierarchized synthetic and bio-inspired functional (liquid crystalline) materials*. Through the rational design, circular chemistry, controlled synthesis, and advanced processing of functional soft materials aiming at encoding complex and efficient functions through hierarchical self-assembly processes across (nano⇒macro) length scales, his research activities deal with boosting efficiencies of electronic, ionic, and protonic transfers at work within active layers of (opto)electronic active devices (ICTs: Organic (Bio)electronics), of proton exchange membranes of fuel cells (Energy generation), of thermoelectric devices (Thermoelectric generators and coolers (TEGs vs. TECs)) and of solid-state electrolytes of batteries & supercapacitors (Energy storage). He combines these (bio)materials science approaches with the developments of (lab & large-scale facility-based) multimodal platforms allowing in depth (*ex/in situ* and *operando*) studies to access (defect-free) intrinsic and ultimate electronic, ionic and protonic transfer performances of functional soft materials towards next generation applications within the fields of ICTs (Nano/Bioelectronics) and Energy generation, harvesting (Hydrovoltaic energy) & storage (Nanonionics/Nanofluidics).

e) Products: 134 publications (**77** regular articles & **57** proceeding papers), **2 book chapters** & **16** (FR/EP/JP/US/WO) **patents. Number of times cited** & **h index** [source: google scholar]> **5.2k** & **35**

d) 8 Products Closely Related to Energy Conversion[2,4,6,8] & Storage[1,3-5,7-8] Endeavors to Address UN SDG N°7

•**1** D. Bresser, M. Leclère, L. Bernard, **P. RANNOU**, H. Mendil-Jakani, G-T. Kim, T. Zinkevich, S. Indris, G. Gebel, S. Lyonnard, Dr. L. Picard, "Organic liquid crystals as single-ion Li^+ conductors", *ChemSusChem.* **14(2)**, 2021, pp 651-6661. **DOI**: 10.1002/cssc.202001995. **Cover Picture**

•**2** A. Le Goff, Y. Nedellec, M. Holzinger, **P. RANNOU**, V. Forge "Ion Exchange Membrane". WO/2021/018983. FR3099648.

•**3** L. Picard, T.F. Clement, **P. RANNOU** "Solid polymer electrolyte made of comb polymer". EP3865533. FR3107276.

•**4** T. Cherian, D. Rosa Nunes, T.G. Dane, J. Jacquemin, U. Vainio, T. Myllymäki, J. Timonen, N. Houbenov, M. Maréchal, **P. RANNOU**, O. Ikkala, "Supramolecular self-assembly of ultraconfined ionic liquids for fast anisotropic ion transport", *Adv. Funct. Mater.* **29(49)**, 2019, 1905054 (8 pages). **DOI**: 10.1002/adfm.201905054

•**5** P. Overton, L. Picard, **P. RANNOU**, "Sulfonamide macromolecules useful as single-ion conducting polymer electrolyte", WO/2019/008061. FR3068693. EP3649107. US20200165197

•**6** E.B. Trigg, T.W. Gaines, M. Maréchal, D.E. Moed, **P. RANNOU**, K.B. Wagener, M.J. Stevens, K.I. Winey, "Self-assembled highly ordered acid layers in precisely sulfonated polyethylene produce efficient proton transport", *Nat. Mater.* **17(8)**, 2018, pp 725-731. **DOI**: 10.1038/s41563-018-0097-2

•**7** L. Picard, G.Gebel, M. Leclère, H. Mendil, **P. RANNOU,** "Electrolyte for Electrochemical Generator". WO2017050769. FR3041358. EP3353262. US20180261886.

•**8** T.F. Clement, L. Picard, **P. RANNOU,** "Method for fluorinated polymer preparation by Ziegler Natta catalysis". EP3763748. FR3097548.

e) Synergistic activities:

2018-present	Co-organizer: grEnoble eNerGy conversIoN & storagE (ENGINE) international winter school Member of ENGINE2019 & ENGINE2021 & ENGINE 2023 Organizing Committee
2016-present	Member of the HDR (habilitation) commission of the EDCSV (ED N°254), Graduate School of Chemistry and Life sciences of the University Grenoble Alpes (UGA).
2015-present	French PI/Assoc. Director of international research for the ANR/NSF "PIRE" project REACT Research and Education in Active Coatings Technologies for the Human Habitat (NSF-OISE PIRE Grant # 1545884 and ANR Grant # ANR-15-PIRE-0001] PI of the French partner (GIANT: 6 labs/18 faculties) for the French National Agency of Research (ANR) Co-Leader of its ACT 3: "Self-assembled Nanomaterials for Energy Generation and Storage"
2013-present	Co-organizer: on Organic Electronics International Summer School (OESS) Member of OESS (2013/2014/2015/2017/2019/2021) Scientific/Steering Committee Member of the OESS013'Organizing Committee: General co-chair (OESS2014), in charge of selecting/contacting its Invited Lecturers, of its Academic Funding/Support
2013-present	Co-organizer: International Conference on Organic Electronics (ICOE)) Member of ICOE (2014/2015/2016/2017/2018/2019/ICOE2022) Scientific/Steering Committee Member of the ICOE2013'Organizing Committee: Programme chair (ICOE2013), in charge of selecting/contacting its Invited Lecturers, of its Academic Funding/Support
2012-present	Co-organizer: Minatec Summer Programme (MSP2011-2013) and Grenoble International Internship Programme (2014/2015/2016/2017/2018/GIIP2019) aiming at international research experience for undergraduate students enrolled in US and Japanese universities. Member of MSP & GIIP scientific/steering committee. Co-organizer: French American Workshop (2012/2013/2014/2015/2016/2017/FAW2018/FAW2019) @ GIANT
2006-present	Co-organizer: International Conference on Molecular Electronics (ElecMol). Member of the ElecMol'Organizing Committee (2005->ElecMol2020): General chair ElecMol10/12, in charge of selecting/contacting its Invited Lecturers, of its Academic Funding/Support
2004-2018	Scientific facilitator (With Dr. J-L. Fave) of a team of 25 French leading experts of the emerging field of organic (opto)electronics and Senior Expert within the Organic Electronics division of the French Observatory of Micro & NanoTechnologies OMNT-UMS2920

f) Collaborators: Prof. Y. Bonnassieux [*UMR7647-LPICM (France)*], Prof. C.J. Brabec [*Friedrich-Alexander-Univ. (Germany)*], Prof. Paul F. Barbara [*Univ. of Texas @ Austin (USA)*], Dr. R. Borsali, [*UPR5301-CERMAV (France)*], Dr. M. Brinkmann [*UPR22-ICS (France)*], Dr. M. Burghammer [*ESRF-ID13 (France)*] Prof. R. Clerc [*IOGS (France)*], Dr. M-N. Collomb [*UMR5250-DCM (France)*], Prof. R.J. Composto [*Univ. of Pennsylvania (USA)*], Dr. Gaël De Paëpe [*CEA-Grenoble/IRIG (France)*], Dr. B. Donnio [*UMR7504-IPCMS (France)*], Prof. Eric Drockenmuller [*UMR5223-IMP (France)*], Prof. Z. Fakhraai [*Univ. of Pennsylvania (USA)*], Prof. C.F.J. Faul [*Univ. of Bristol (UK)*], Dr. V. Forge [*UMR5249-LCBM, (France)*], Dr. G. Fragneto [*Institut Laue-Langevin (France)* , Prof. T. Forsyth [*Keele University (UK) & Institut Laue-Langevin (France)*], Dr. M. Frigoli [*UMR-8180-ILV (France)*], Dr. D. Gasparutto [*UMR5819-SyMMES (France)*], Dr. Alain Graillot [*Specific Polymers (France)*], Dr. S. Halila, [*UPR5301-CERMAV (France)*], Prof. Olli T. Ikkala [*Aalto Univ. (Finland)*], Prof. M. Leclerc [*Univ. Laval (Canada)*], Dr. C. Loubat [*Specific Polymers (France)*], Dr. S. Malburet [*Specific Polymers (France)*], Prof. I. McCulloch [*Univ. of Oxford (UK)*], Prof. C.B. Murray [*Univ. of Pennsylvania (USA)*], Dr. T. Narayanan [*ESRF-ID02 (France)*], Prof. P.F. Nealey [*Univ. of Chicago (USA)*], Dr. F. Ota, [*Hitachi Chemical Co., Ltd (Japan)*], Prof. A.Padua [*UMR5182-LCH (France)*]Prof. H.S. Park [*Sungkyunkwan Univ.* (South Korea)], Prof. A. Pron [*Warsaw Univ. of Technology (Poland)*], Prof. S. Sanaur [*ENS Mines de Saint-Etienne/CMP (France)*], Dr. H. Uehara [*Hitachi Chemical Co., Ltd (Japan)*], Dr. M. Vilkman [*VTT Technical Research Center of Finland (Finland)*], Prof. C.G. Willson [*Univ. of Texas @ Austin (USA)*], Prof. K.I. Winey [*Univ. of Pennsylvania (USA)*], Prof. G-R. Yi [*POSTECH (South Korea)*], Dr. A. Yassar [*UMR7647-LPICM (France)*], Prof. P.J. Yoo [*Sungkyunkwan Univ.* (South Korea)]

g) Graduate & Postdoctoral Advisors:
Dr. M. Nechstchein, Retired, formely DR1**/**Directeur de Recherche 1ère Classe CNRS: Thesis Advisor
Dr. T. Saitoh, Retired, formely Director of the New Materials Laboratory R&D Center, Hitachi Chemical. Co. Ltd, Japan: Postdoctoral Advisor

h) Thesis Advisor, Date [*affiliations*] (8 total): Bruno Dufour, 10/02 [*Hutchinson (France)*], Jean-Pierre Bonnet, 10/03 [*UMR7314-LRCS (France)*], Sirine Layouni, 07/18 *(Tunisia)*, Sandrine Martins, 02/05 *(France)*, Anaëlle Rongier, 02/18 [*STmicroelectronics (France)*], Sun-Jae Lee, 07/18 [Soitec (France)], Philip Overton, 03/19 [*Department of Chemistry, Simon Fraser University (Canada)*], T.F. Clement, 03/21 [*CEA-Liten (France)*].

i) Postdoctoral Associates [*affiliations*] (15 total): E.C. Castillon Gonzales (*Spain*), J. Champavert (*France*), C. Fernandez de Alba Encinas (*Spain*), A. Kyndiah [*UMR5218 (CNRS/Univ. Bordeaux/Bordeaux Aquitaine INP)-IMS (France)*], O. Jaudoin (*France*), L. Goujon [*UPR5301-CERMAV (France)*], A. Iwan [*General Tadeusz Kosciuszko Military Univ of Land Forces (Poland)*], G. Jo *(South Korea)*, J. Majoinen [*Aalto University (Finland)*], F. Mathevet [*CNRS-UMR7610-Laboratoire de Chimie des Polymères [CNRS/UMPC-Paris VI] (France)*], M. Mohankumar Sreelatha [*Department of Chemistry, Bar-Ilan Univ. (Israël)*], F. Oswald [*CEA-Saclay (France)*], François Pourtier [UPR-5301-*CERMAV (France)*], Amrit Puzari [*GIMT/Guwahati University & NIT Nagaland (India)*], S. Zaioncz (*Brazil*)

j) Present Group:
PhDs **(3)**: J. Hurtaud ['22], Y. Nait Abdi ['23], H. Pung ['23]. Postdoctoral Fellows **(2)**: Dr. G. Sych ['23], Dr. H.H. Rana ['24]

k) Total Advisees Since 1999: Undergraduates: **19.** M.Sc. Students: **16.** PhD Students: **11.** Postdoctoral Fellows: **17**

l) Research Areas

-Circular chemistry towards functional (Multi-Block) Molecules, Macromolecules, Supramolecules & Supramacromolecules
-Self-Organized (Bio-sourced/inspired/mimetic) π-Conjugated (Semi)Conducting & Ionically Conducting Materials
-Energy Generation (PEMFCs), Harvesting (TEGs & TECs), and Storage (battery & supercaps)
-Organic/Plastic & (Supra)Molecular (Opto)Electronics , Nanoionics/Nanofluidics, Iontronics
-Multi-Scale/Physics Structure/(Electronic/Ionic/Protonic) Transport Correlations through *ex/in situ & operando* (lab & large-scale facility-based) advanced characterizations & using devices as platforms to enable efficient feedback loops for materials design

m) Research Interests & Keywords

-**Organic & (Supra/Macro)Molecular Chemistry**: *(Macro/Supra)Molecular Engineering Approaches & Synthetic Routes towards Oligomer, Homopolymer, Alternated Copolymer, Multi-block Molecules/Copolymer & Dendritic Functional Architectures*
-**1D vs. 2D vs. 3D Self-Assembly of Functional Materials**: *Controlled Phase Segregation (Self-organization & Hierachization) in (Multiblock) Functional Architectures based on Covalent & Non-Covalent (Ionic, H-Bonding, van der Waals..) Interactions*
-**π-Conjugated Materials**: *Organic SemiConductors (thiophene-based OSCs) & Organic Conductors (aniline-based OCs)*
-**Organic Single Crystals & Liquid Crystals (LCs)**: *Molecular OSCs, Calamitic/Sanidic/Polycatenar Functional LC OSCs*
- **Bio-sourced/inspired/mimeticOSCs**: *DNA-OSC Hybrids, Self-Assembled Oligo(Peptide)s (Quantum Dots (QDs) & Nanotubes (NTs)), Proteins, Amyloid fibers*
-**Single-Ion Conducting Materials**: *Homo/Block Co-polymers*
-**Organic Mixed Ionic-Electronic Conductors** (**OMIECS**): (*Macro)Molecular & Hybrid (Organic/Inorganic) MIECs*
-**Ionic/Electronic Transport & Optoelectronic Properties**: *dc-Conductivity, Charge Carrier Mobility (SCLC/OFET), Electrochemical Impedance Spectroscopy (EIS), Electronic & Energy & Ionic Transfers*
-**Optoelectronic & Iontronic Devices**: *Organic Field-Effect Transistors (OFETs), Organic Solar Cells (Donor/Acceptor Heterojunctions), Organic ElectroChemical Transistors (OECTs), Batteries, Supercapacitors*

m) On Going National & International Funded Projects (Research Grants)

French National Agency of Research (ANR)
•**2016-2022**: GATE ⇨Generic Approach To new organic semiconductors for Electronic applications
PI: Dr. M. Frigoli (CNRS). Co-PIs: Dr. P. Rannou (CNRS) & Dr. A. Yassar (CNRS)
•**2020-2024**: MASTERMIND⇨ MultiscAle STructure/propERty relationship in MIxed (ionic/electronic) (macro)molecular coNDuctors: Towards new generation organic bioelectronics devices
PI: Dr. S. Sanaur (ENSMSE-CMP). Co-PIs: Dr. P. Rannou (CNRS), Dr. Y. Bonnassieux (X-Ecole Polytechnique)
•**2021-2025**: SWEET-DISPLAY⇨A convenient approach to glycoamphiphiles as active layers of LCD-based biosensors
PI: Dr. S. Halila (CNRS). Co-PIs: Dr. P. Rannou (CNRS)
Horizon Europe & Horizon 2020 Framework Programs of the European Community (H2020/Horizon Europe)
•**2022-2024**: HOPES (H2020-MSCA-IF-2020)
self-assembled/healable Hybrid inorganic/Organic Polymer Electrolytes for sustainable electrochemical energy Storage
PI: Dr. P. Rannou (CNRS). MSCA Fellow: Dr. H.H. Rana. Industrial Secondment @ Specific Polymers
•**2020-2023**: HIDDEN (LC-BAT-14-2020), 1 of the 6 projects of the H2020-FET-Flagship large-scale initiative Battery2030+
⇨HInDering DENdrite growth in lithium metal batteries (HIDDEN)
Partners: VTT, CNRS, CSEM, BFH, BELENOS CLEAN POWER HOLDING AG, SECIFIC POLYMERS, RTD TALOS LTD
PHC STAR (France + South Korea): bilateral collaboration (PHC STAR)
•**2019-2022**: PIONEER⇨Research and Education in Active Coatings Technologies for the Human Habitat
French PI: Dr. P. Rannou (CNRS). South Korean PI: Dr. P.J. Yoo.
FACCTS: French Chicago Center (FCC), Embassy of France (USA) & TUniversity of Chicago : France+USA bilateral collaboration
•**2020-2023**: ILLINOIS (FACCTS 2020) ⇨"Thermotropic Ionic Liquid crystaL: Encoding dImensionality-controlled & NanocOnfined Ionic tranSport"
French PI: Dr. Patrice Rannou (CNRS). US PI: Pr. P.F. Nealey (U. Chicago)

o) 9 Other Significant Products

•**1:** "Unidirectional perpendicularly aligned lamella-structured oligosaccharide (A) ABA triblock elastomer (B) thin films utilizing triazolium+/TFSI- ionic nanochannels", *ACS Macro Lett.* **11(1)**, 2022, pp 140-148. **DOI**: 10.1021/acsmacrolett.1c00712
•**2:** "UV-Vis-NIR optical properties of amyloid fibrils as a new light on amyloidogenesis", *Nat. Photon*. **13(7)**, 2019, pp 473-479. **DOI**: 10.1038/s41566-019-0422-6
•**3:** "Dynamic self-assembly of DNA minor groove-binding ligand DB921 into nanotubes triggered by an alkali halide", *Nanoscale* **10(12)**, 2018, pp 5550-5508. **DOI**: 10.1039/c7nr03875e
•**4** "A synthetic redox biofilm made from metalloprotein-prion domain chimera nanowires", *Nat. Chem.* **9(2)**, 2017, pp 157-163. **DOI**: 10.1038/nchem.2616
•**5** "Improvement of the Seebeck coefficient of PEDOT:PSS by chemical reduction and method for its transfer using free-standing thin films", *J. Mater. Chem. C* **2(7)**, 2014, pp 1278-1283. **DOI**: 10.1039/C3TC31674B
•**6** "From block copolymer self-assembly, liquid crystallinity, and supramolecular concepts to functionalities", Handbook of Liquid Crystals, 2nd edition, Eds. J.W. Goodby, P.J. Collings, T. Kato, C. Tschierske, H. Gleeson, P. Raines, **ISBN-13: 978-3-527-32773-7**, Wiley-VCH, Weinheim, Germany, Vol.7: Supramolecular & Polymer Liquid Crystals, 2014, pp 541-598. **DOI**: 10.1002/9783527671403.hlc122. **Invited Handbook Chapter**
•**7.** "Delineating poly(aniline) redox chemistry using tailored oligo(aryleneamine)s: Towards oligo(aniline)-based organic semiconductors with tunable optoelectronic properties", *Chem. Eur. J.* **17(44)**, 2011, pp 12512-12521. **DOI**: 10.1002/chem.201101697
•**8.** "Self-assembly and hierarchies in pyridine-containing, homopolymers and block copolymers with hydrogen-bonded cholesteric side-chains, *Macromolecules* **43(3)**, 2010, 1507-1514. DOI: 10.1021/ma9021604
•**9.** "Processible conjugated polymers: From organic semiconductors to organic metals and superconductors", *Prog. Polym. Sci.* **27(1)**, 2002, pp 135-190. **DOI**: 10.1016/S0079-6700(01)00043-0. **Invited Review**