

Self-Organizing Matter, W.L. Noorduin (2017-2022)

Biography



Wim Noorduin leads the Self-Organizing Matter group at AMOLF and is professor by special appointment at the University of Amsterdam. He is co-founder (and currently scientific advisor) of Lumetallix, a startup company that exploits innovative photoluminescent technology for mitigating lead pollution.

In 2010, Noorduin received his PhD from Radboud University under guidance of Prof Elias Vlieg. From 2010 to 2013, he joined the group of Prof Joanna Aizenberg at Harvard University as a postdoctoral researcher. From 2014 to 2015, he functioned as both a research associate at Harvard University and an assistant professor at Radboud University. From 2015 onwards, he has been leader of the Self-Organizing Matter group at the NWO-Institute AMOLF in Amsterdam.

Noorduin's research focuses on the dynamic interplay between chemical reactions and crystallization phenomena to control the emergence of complexity in the solid state. His group is known for designing physical/chemical schemes to self-organize complex materials and develop new chiral amplification methods for the synthesis of enantiomerically pure building blocks. Current research includes the development of new routes to control crystallization, material composition, shape and hierarchical organization of mineralized structures and the design of physical/chemical feedback mechanisms to self-correct and amplify the emergence of complexity. His research is funded by various grants, including the ERC Consolidator, and Veni, Vidi and KLEIN grant from the Netherlands Organization for Scientific Research.

Group output

Peer reviewed Publications 2017-2022

2017

1. C.N. Kaplan[†], W.L. Noorduin[†], L. Li, R. Sadza, L. Folkertsma, J. Aizenberg, L. Mahadevan "Controlled growth and form of precipitating microsculptures" *Science*, 355, 1395, (2017).
[†]shared first author.

2018

1. I. Baglai, M. Leeman, K. Wurst, B. Kaptein, R.M. Kellogg and W.L. Noorduin, *The Strecker reaction coupled to Viedma ripening: a simple route to highly hindered enantiomerically pure amino acids*, *Chem. Commun.* 54, 10832-10834 (2018). **Green OA**
2. W.J.P. van Enckevort, W.L. Noorduin, Graswinckel S., P. Verwer and E. Vlieg, *Epitaxy of Anthraquinone on (100) NaCl: A Quantitative Approach*, *Cryst.Growth Des.* 18, 5099-5107 (2018). **Gold OA**
3. T. Holtus, L. Helmbrecht, H.C. Hendrikse, I. Baglai, S. Meuret, G.W.P. Adhyaksa, E.C. Garnett and W.L. Noorduin, *Shape-preserving transformation of carbonate minerals into lead halide perovskite semiconductors based on ion exchange/insertion reactions*, *Nature Chem.* 10, 740-745 (2018). **Green OA**
4. L. Li, A. J. Fijneman, J. A. Kaandorp, J. Aizenberg and W.L. Noorduin, *Directed nucleation and growth by balancing local supersaturation and substrate/nucleus lattice mismatch*, *PNAS* 115, 14: 3575-3580 (2018). **Green OA**

2019

1. Baglai, M. Leeman, B. Kaptein, R.M. Kellogg and W.L. Noorduin, A chiral switch: *balancing between equilibrium and non-equilibrium states*, Chem. Commun. **55**, 6910-6913, (2019). **Green OA**
2. Baglai, M. Leeman, R.M. Kellogg and W.L. Noorduin, A Viedma, *ripening route to an enantiopure building block for Levetiracetam and Brivaracetam*, Org. Biomol. Chem **17**, 35-38 (2019). **Green OA**

2020

1. H. C. Hendrikse[†], A. van der Weijden[†], M. Ronda-Lloret, T. Yang, R. Bliem, N. Raveendran Shiju, M. Van Hecke, L. Li, W. L. Noorduin "Shape-Preserving Chemical Conversion of Architected Nanocomposites" Advanced Materials 2003999, (2020). (Highlighted in Nature and Nature Review Materials), **Green OA**.
2. I. Baglai, M. Leeman, K. Wurst, R. M. Kellogg, W. L. Noorduin, "Enantiospecific Solid Solution Formation Triggers the Propagation of Homochirality" Angewandte Chemie International Edition **59**, 20885, (2020), **Green OA**.
3. L. Helmbrecht, M. Tan, R. Röhrich, M. H. Bistervels, B. Ortiz Kessels, A. F. Koenderink, B. Kahr, W. L. Noorduin, "Directed Emission from Self-Assembled Microhelices" Advanced Functional Materials, **30**, 1908218, (2020). (front cover special issue Assembly of Materials Building Blocks into Integrated Complex Functional Systems), **Green OA**.
4. F. Breveglieri, I. Baglai, M. Leeman, W.L. Noorduin, R.M. Kellogg and M. Mazzotti, "Performance analysis and model-free design of deracemisation via temperature-cycles" Organic Process Research & Development **24**, 1515-1522, (2020), **Hybrid OA**.

2021

1. G. Grimaldi, L.S.D. Antony, L. Helmbrecht, A. van der Weijden, S.W. van Dongen, I. Schuringa, J. Borchert, E. Alarcón-Lladó, W.L. Noorduin and B. Ehrler, *Microstructuring of 2D perovskites via ion-exchange fabrication*, Appl. Phys. Lett. **119**, (22), 223102: 1-8 (2021), **Hybrid OA**
2. A.V. Mader, L. Helmbrecht and W.L. Noorduin, *Multi-layered Barium and Strontium Carbonate Structures Induced by the Small Organic Dye Acid Orange 7*, Cryst.Growth Des. **21**, (11), 6349-6356 (2021), **Hybrid OA**
3. Baglai, S.W. van Dongen, M. Leeman, R.M. Kellogg, B. Kaptein and W.L. Noorduin, *Counteracting Enantiospecific Behavior of Tailor-Made Additives During Chiral Symmetry Breaking: Growth Inhibition versus Solid-Solution Formation*, Isr. J. Chem. **61**, (9-10), 645-649 (2021), **Hybrid OA**
4. H.C. Hendrikse, H.-C. Stivel, L. Helmbrecht, E.P. van Dam, E.C. Garnett and W.L. Noorduin, *Shaping Tin Nanocomposites through Transient Local Conversion Reactions*, Cryst.Growth Des. **21**, (8), 4500-4505 (2021), **Hybrid OA**
5. H.C. Hendrikse, A. Aguirre, A. van der Weijden, A.S. Meeussen, F. Neira D'Angelo and W.L. Noorduin, *Rational Design of Bioinspired Nanocomposites with Tunable Catalytic Activity*, Cryst.Growth Des. **21**, (8), 4299-4304 (2021), **Hybrid OA**
6. M.M.J. van Rijt, S.W. Nootboom, A. van der Weijden, W.L. Noorduin and G. de With, *Stability-limited Ion-exchange of Calcium with Zinc in Biomimetic Hydroxyapatite*, Materials & Design **207**, 109846: 1-7 (2021) **Hybrid OA**
7. L. Helmbrecht, M.H. Futscher, L.A. Muscarella, B. Ehrler and W.L. Noorduin, *Ion Exchange Lithography: Localized Ion Exchange Reactions for Spatial Patterning of Perovskite Semiconductors and Insulators*, Adv. Mater. **33**, (20), 2005291: 1-6 (2021), **Hybrid OA**
8. G. Valenti, P. Tinnemans, I. Baglai, W.L. Noorduin, B. Kaptein, M. Leeman, J.H. ter Horst and R.M. Kellogg, *Combining incompatible processes for deracemization of a Praziquantel derivative under flow conditions*, Angew. Chem. Int. Ed. **60**, (10), 5279-5282 (2021), **Green OA**

2022

1. C.T. van Campenhout, D.N. ten Napel, M. van Hecke and W.L. Noorduin, *Rapid formation of uniformly layered materials by coupling reaction–diffusion processes with mechanical responsiveness*, PNAS **119**, (39), e2123156119: 1-6 (2022), **Green OA**
2. A. van der Weijden, M. van Hecke and W.L. Noorduin, *Contraction and expansion of nanocomposites during ion exchange reactions*, Cryst.Growth Des. **22**, (4), 2289-2293, (2022) **Hybrid OA**
3. M.H. Bistervels, M. Kamp, H. Schoenmakers, A.M Brouwer and W.L. Noorduin, *Light-Controlled Nucleation and Shaping of Self-Assembling Nanocomposites*, Adv. Mater. **34**, (5), 2107843: 1-7 (2022) **Hybrid OA**

Contributions to scientific books (chapters or entire book) 2017-2022

N/A

PhD theses 2017-2022

2020

1. L. Helmbrecht, *“Ion Exchange, Self-Assembly, and Light Emission”. A Dance of Ions and Light*, University of Amsterdam, 2020-11-20.

2021

1. H.C. Hendrikse, *On the Conversion of Nanocomposite Architectures*, University of Amsterdam, 26/02/2021 Embargo

Masters and Bachelor theses 2017-2022

2018

1. BSc thesis; Ariane Mader (2018), *Investigating the Effects of Organic Dyes as Additives on the Growth of Silica Biomorphs*, Maastricht University
2. BSc thesis; Bruno Ortiz Kessels (2018), *The directional emission of self-assembled microstructures*, Eindhoven University of Technology
3. MSc thesis; Arno van der Weijden (2018) *Microarchitectures with controllable compositions and shapes*, Radboud University Nijmegen

2019

1. MSc thesis; Stivell Hemon-Charles, *Self-assembly of functional microarchitectures: synthesis and characterization of tin perovskite*, University of Nantes, France, 2019.
2. MSc thesis; Alicia McTaggart, *Towards Controlling the Growth of Silica-carbonate and Vaterite Microstructures*, Concordia University, Canada, 2019.
3. BSc thesis; Nesrine Jamal, *3D-printing: a novel approach to enantiomeric purity*, Hogeschool Inholland, the Netherlands, 2019.
4. BSc thesis; Imane Ahlal, *Enantiomeric enrichment during crystallization*, Hogeschool Inholland, the Netherlands, 2019-2020.

2021

1. MSc thesis; Pietro Sofia, *“Light-driven manipulation of a bio-inspired co-precipitation process: self-assembly of SrCO₃ / SiO₂ microarchitectures”*, master’s thesis, University of Bologna, Italy, 01/2021.
2. MSc thesis; Wouter Meering, *“Modelling crystal growth with a spatiotemporal accretive growth model”*, master’s thesis, University of Amsterdam, The Netherlands, co-supervised with Dr. Jaap Kaandorp, 03/2021.

3. BSc thesis; Miriam Ait Afkir, "*Easy Enantiopurity: Controlling Conglomerate Forming Conditions*", bachelor's thesis, InHolland, Amsterdam, The Netherlands, 09/2021.
4. MSc thesis; Anne-Sophie Léonard, "*Ion-exchange reactions as a route for functional materials*", master's thesis, KU Leuven, Belgium, 07/2021.
5. MSc thesis; J. J. Rietveld, "*User-defined Manipulation of Silver Hydrogels*", master's minor internship report, 29/12/2021.

2022

1. BSc thesis; M.A. Afkir, *Easy Enantiopurity: Controlling Conglomerate Forming Conditions*, bachelor's thesis, InHolland, Amsterdam, The Netherlands, 09/2021

Invited lectures at international conferences and meetings

2017

1. UCL chemistry/physics colloquium, University College London, London, UK, 27 November 2017, *Self-assembled functional materials* (invited lecture).
2. Xiamen Soft Matter Forum 2017, Xiamen, China, 3 November 2017, *Self-assembled functional microstructures* (invited lecture).
3. Chemistry department Colloquium, University of Bayreuth, Bayreuth, 9 January 2017, *Designing complex microstructures* (invited lecture).

2018

1. W. L. Noorduin, Solvay workshop "Chiral Symmetry Breaking at Molecular Level", Brussels, Belgium, 29 November 2018, *Physical chemical routes to single handedness* (invited lecture).
2. W. L. Noorduin, Sixth European Conference on Crystal Growth (ECCG6), Varna, Bulgaria, 17 September 2018, *Controlling nucleation, growth and form of bio-inspired minerals* (invited lecture, awarded best conference presentation).
3. W. L. Noorduin, Biomineralization Gordon Research Conference, Colby-Sawyer College, New London (NH), US, 2 August 2018, *Bio-inspired assembly of micro-architectures* (invited lecture).
4. W. L. Noorduin, CIMTEC Congress 2018, Perugia, Italy, 12 June 2018 *Bio-inspired self-organization of functional materials* (invited lecture).
5. W. L. Noorduin, The 1st JAIST World Conference, Japanese Advanced Institute of Science and Technology, Nomi, Ishikawa, Japan, 27-28 February 2018, *Bioinspired functional materials* (invited lecture).
6. L. Helmbrecht (talk), Converting rationally designed mineral architectures into semiconductors (2018). physics@Veldhoven, Veldhoven, The Netherlands
7. L. Helmbrecht (talk), Self-assembly of functional microshapes, ARCNL/AMOLF meeting, Amsterdam, The Netherlands
8. L. Helmbrecht (poster) (2018) Metaminerals: Decoupling Shape and Composition. Gordon Research Conference on Biomineralization, New London, NH, The United States of America

2019

1. *Physical Chemical Routes to Single Handedness*, Chirality@Nanoscale, Ascona, Switzerland, October 14-17, 2019.
2. *Shaping up bio-inspired functional materials*, 2019 annual British Association of Crystal Growth symposium, London, UK, July 10, 2019.
3. *Non-classical nucleation and growth*, Gordon Research conference 2019 Crystal Growth and Assembly, Manchester NH, USA, June 25, 2019. (discussion leader)

2020

1. Gordon Research Conference "Systems Chemistry", 28 June-3 July 2020, Sunday River, Maine, USA: *A constructive chemical conversation (cancelled due to COVID)*.

2021

1. M.H. Bistervels, M. Kamp, H. Schoenmaker, A.M Brouwer and W.L. Noorduin, "*Light-Controlled Nucleation and Shaping of Self-Assembling Nanocomposites*", COST Action Chemobrionics Annual Meeting, Ankara, Turkey, 22-24/09/2021.
2. W.L. Noorduin, "*Self-organizing Matter for Functional Materials*", COST Action Chemobrionics Annual Meeting, Ankara, Turkey, 22-24/09/2021.
3. W.L. Noorduin, "*Helical self-assembled nanocomposites*", ACCGE-22/OMVPE-20 2021 Symposium on Twisted crystals (online), USA, 04/08/2021.

2022

1. W.L. Noorduin Self-organization for shaping up materials NWO CHAINS 2022, Veldhoven, The Netherlands, (invited keynote lecture) 22/9/2022.

Academic teaching 2017-2022

2021

1. W.L. Noorduin: Guest lecture University of Amsterdam Supramolecular Chemistry and Nanomaterials (Master Chemistry)

2022

1. Marloes Bistervels, Guidance of Bachelor student (Niels Hoogendoorn), Bachelor Project Bachelor Schei-Natuurkunde, Universiteit Utrecht, The Netherlands, 09/2022-01/2023, (40 ECTS course)
2. W.L. Noorduin, MSc level course (co-teaching) Supramolecular Chemistry and Nanomaterials, University of Amsterdam, The Netherlands (5 ECTS course)

Selected awards & recognitions 2017-2022

2018

1. VIDI
2. Poster Price Granada ISC

2019

1. Soft Advanced Materials (ENW-PPS), led by Prof. Katja Loos (RUG).
2. ENW KLEIN 1 grant, Netherlands Organisation for Scientific Research (NWO).

2020

1. ENW XS grant, Netherlands Organisation for Scientific Research (NWO).

2021

1. CHAINS Poster Prize for: Ariane V. Mader, Lukas Helmbrecht, Willem L. Noorduin, "*Multi-layered Barium Carbonate Structures Induced by the Small Organic Dye Acid Orange 7*", CHAINS, Veldhoven (online), The Netherlands, 06/12/2021.

2022

1. EIC Pathfinder, led by Prof. Alejandro Martinez, European Research Council.
2. ERC Consolidator, European Research Council.
3. Marloes Bistervels, Winner of Young Speaker Contest, title: Light-controlled nucleation and shaping of self-assembling nanocomposites, FYSICA 2022, Universiteit Twente, 22/04/2022
4. Marloes Bistervels, Winner of best oral presentation, title: Light-directed crystallization, HIMS annual symposium, Universiteit van Amsterdam, 15/6/2022
5. Marloes Bistervels, Winner of an IUCr Young Scientist Award: Acta Cryst. B Prize for the Best Oral Presentation from an early-career researcher, title: Light-directed crystallization, ECCG7, Paris, 27/07/2022
6. ECCG 2022 (Paris, France) : Runner-Up Best Oral Presentation
Sjoerd W. van Dongen - "Chiral Amplification during Crystallization under Racemizing Conditions"

Valorization 2017-2022

1. 2015-now collaboration with the contract research companies Symeres BV and InnoSyn BV working on development of new routes towards enantiomerically pure molecules (resulted in 9 papers in that period). 2020: Take-off Phase 1 grant, Netherlands Organisation for Scientific Research (NWO) to explore technical and economic feasibility of a new method for making new enantiomerically pure molecules for pharmaceuticals.
2. 2019: developed commercially viable method for synthesizing an enantiomerically pure building block of the active pharmaceutical ingredients of the anti-epileptic's drugs Levetiracetam and Brivaracetam.
3. 2020: Established new contacts during invited lecture at Janssen: Pharmaceutical Companies of Johnson & Johnson, "physical chemical routes to enantiomerically pure molecules" Beerse, Belgium, 17 February 2020.
4. 2021: L. Helmbrecht, W. L. Noorduyn, "Method for detecting lead" EP Patent Application, filed April 6, 2021 EP21166957 patent currently submitted for national phase.
5. 2021: Take-off Phase 1 grant, Netherlands Organisation for Scientific Research (NWO) to explore technical and economic feasibility of new lead testing method.
6. 2022 : Take-off Phase 2 grant (250k), Netherlands Organisation for Scientific Research (NWO) to bring new lead method to the market with the startup Lumetallix.
7. 2022: co applicant of ECG Pathfinder grant with as industrial partner the contract research company Symeres BV, to work on chiral separation processes using light
8. 2023: via Lumetallix developed commercial lead test which is available at [amazon.com](https://www.amazon.com) in the USA, and currently used in NGO missions in Ivory Coast and India.