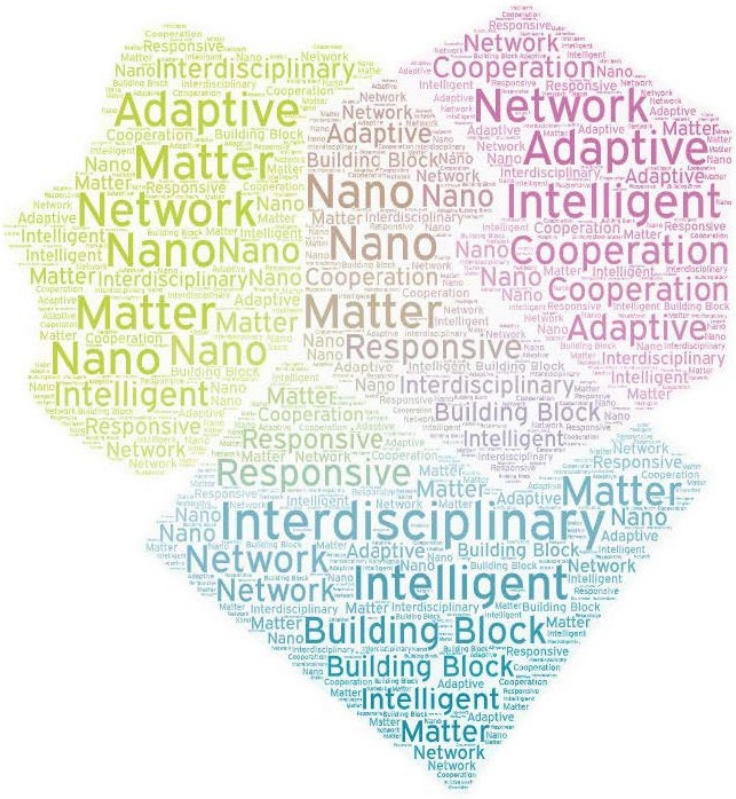
Universität Münster

Center for Soft Nanoscience

CRC 1459 INTELLIGENT MATTER

CRC 1459
Fall Colloquium 2023

November 30th, 2023 | 3:00pm | SoN 100.004
Münster, Germany



Booklet of Abstracts

Program

3:00 pm

Eva Blasco

Chair: Sebastian Baumert

IMSEAM, Heidelberg University, Germany

Designing Intelligent Materials for 4D (Micro)Printing

4:15 pm

Martin van Hecke

Chair: Marc Beuel

AMOLF Amsterdam, The Netherlands

Emergent Computing in Mechanical Metamaterials

5:30 pm

CRC1459 Networking Event

Please see our website www.uni-muenster.de/SFB1459/events for updates
or contact crc1459@uni- muenster.de if you have any questions!

Speakers

Prof. Dr. Eva Blasco

Institute for Molecular Systems Engineering & Advanced Materials (IMSEAM)
Heidelberg University
Germany

Eva Blasco studied Chemistry at the University of Zaragoza in Spain, where she completed her doctoral studies in 2013. She then moved to the Karlsruhe Institute of Technology (KIT), where she first worked as an Alexander von Humboldt fellow and later as a group leader at the Institute of Nanotechnology. She has been a junior professor at Ruperto Carola since October 2020. Eva Blasco is also a principal investigator in the Excellence Cluster "3D Matter Made to Order" (3DMM2O), a collaboration of Heidelberg University and the KIT. She is now a junior professor at the Institute of Organic Chemistry and the Institute for Molecular Systems Engineering and advanced Materials of Heidelberg University. She received the Outstanding Young Researcher in Polymers Award 2022 of the Spanish Royal Society of Chemistry, a Dr. Hermann Schnell Scholarship 2022 for outstanding young researchers and the Ernst-Haage-Award 2022 for Chemistry.

Eva Blasco's work is at the interface of organic and macromolecular chemistry and materials sciences. Her projects focus on developing intelligent functional materials for 3D and 4D printing. Taking inspiration from nature, one of her main goals is the incorporation of "life-like" behaviour into synthetic materials by combining stimuli-responsive polymers and 3D printing technologies at the microscale. This method is called 4D microprinting, and the additional fourth dimension refers to the ability of a three-dimensionally printed object to change its properties over time.

Designing intelligent materials for 4D (Micro)Printing

Eva Blasco, IMSEAM, Heidelberg University, Germany

4D printing has become a promising tool for the fabrication of dynamic and adaptive structures. During the last years, promising examples of defined 4D microstructures employing stimuli-responsive materials have been shown using two-photon 3D laser printing. In this lecture, I will present our recent work on the field with emphasis on new responsive materials enabling the preparation of adaptive and structures. In particular, shape memory polymers as well as liquid crystal

elastomers have been explored. In the first case, a simple and versatile formulation has been developed enabling complex microstructures with remarkable shape memory properties. Also, multi-responsive structures using photo responsive liquid crystal elastomers, are demonstrated. Furthermore, we have exploited the inclusion of dynamic and living bonds in a printable formulation enabling the creation of microstructures with „life-like" characteristics such as adaptability by tunable shape and mechanical properties. For example, a dramatic increase of the volume (eight times) of the 4D microstructure together with an increase of the Young's Modulus by two orders of magnitude is possible, while maintaining the shape including fine structural details. We envision that this programable materials will open new opportunities for the additive manufacturing of functional devices.

References:

[1] *C. A. Spiegel, M. Hackner, V. P. Bothe, J. P. Spatz, E. Blasco, Adv. Funct. Mater.* ***2022****, 144, 2110580.*

[2] *L.-Y. Hsu, P. Mainik, A. Münchinger, S. Lindenthal, T. Spratte, A. Welle, J. Zaumseil, C. Selhuber-Unkel, M. Wegener, E. Blasco, Adv. Mater. Technol.* ***2022****, 2200801.*

[3] *P. Mainik, L-Y. Hsu, C. W. Zimmer, D. Fauser, H. Steeb, E. Blasco, Adv. Mater. Technol.* ***2023****, 2300727.*

[4] *Y. Jia, C. A. Spiegel, A. Welle, S. Heißler, E. Sedghamiz, M. Liu, W. Wenzel, M. Hackner, J. P. Spatz, M. Tsotsalas, E. Blasco, Adv. Funct. Mater.* ***2022****, 2207826.*

Prof. Dr. Martin van Hecke

AMOLF
Amsterdam
Leiden University
The Netherlands

Martin van Hecke is a group leader at AMOLF, Amsterdam, and a professor of physics at Leiden University. He works on the emergence of complex behavior in flexible and frustrated matter, combining experiments, simulations and theory. In the past decade he developed programmable, shape-shifting and self-folding metamaterials which straddle the boundary between material and machine; he is currently exploring how complex materials – from multistable metamaterials to crumpled sheets – can be understood from the perspective of information processing.

Emergent Computing in Mechanical Metamaterials

Martin van Hecke, AMOLF Amsterdam, The Netherlands

Bistable elements, controlled by buckling and snapping, naturally act as mechanical bits. The central tenet of this talk is that interactions between such bits allow flexible (meta) materials to exhibit complex orbits and store and process information - and that this strategy can be expanded to other material systems with bistable elements. I will discuss metamaterials that count how often they are compressed and that can select and process input strings composed of complex compression cycles. These materials can be mapped to finite state machines so that their computational power can precisely be characterized. This work shines new light on the nonlinear response of complex materials and opens the door to ‘intelligent matter’.