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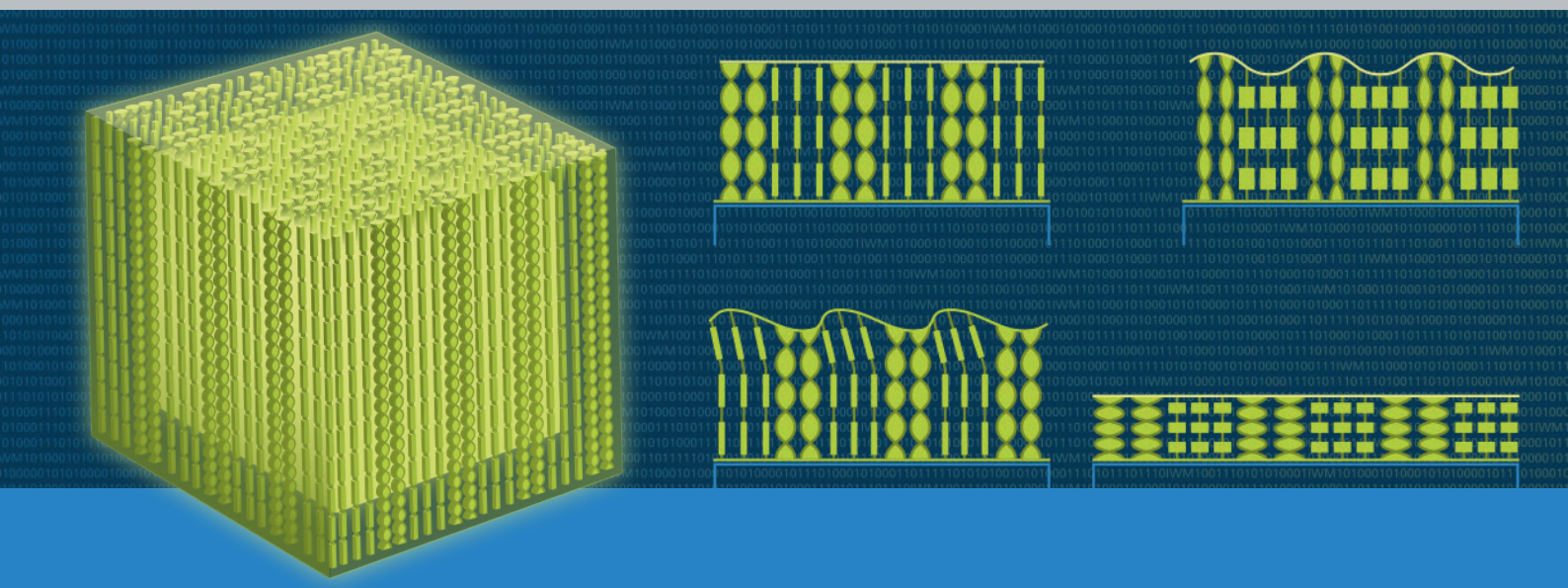
FRAUNHOFER CLUSTER OF EXCELLENCE PROGRAMMABLE MATERIALS CPM



FOSTERING THE PARADIGM SHIFT IN MATERIALS RESEARCH

International Conference on Programmable Materials

27 – 29 April 2020, Berlin

International conference on programmable materials – fostering the paradigm shift in materials research

Global challenges such as sustainable development, climate change, renewable energy, or individual mobility increase the necessity for a much more efficient and sustainable use of our resources. Programmable materials have the potential to initiate a paradigm shift since they can perform system functions through their internal design. This allows for increased functional integration while simultaneously reducing system complexity.

Programmable materials are materials whose inner structure is designed and manufactured in such a way that properties and behavior can be controlled and reversibly changed. Furthermore, locally varying functions can be programmed into such materials.

Fully functional programmable materials require a combination of smart materials, mechanical and optical meta materials, the ability to manufacture architectured materials through e.g. additive manufacturing or sheet metal forming. Last but not least a highly interactive, interdisciplinary application design route is necessary to exploit the full potential.

This opens up possibilities for novel application solutions where essential parts of system functionality are provided by the material itself. The programming ability stems from build in logical elements (e.g. if $T > 380\,K$ then $E = 10\,GPa$ else $E = 1\,GPa$, with E being the Young's modulus), materials memory (e.g. bistable mechanical or molecular states) and the ability to process functions (e.g. Poisson number as a function of strain in x-direction: $\nu = f(\varepsilon_x)$). The material response can either be triggered externally or the materials can automatically adapt to changing conditions in a predetermined manner.

The application potential for programmable materials is immense: programmable pore sizes enable self-cleaning membrane filters for water treatment systems, materials with programmable heat transfer ensure energy-efficient heat management in machines or buildings, shape morphing materials can change aerodynamics and programmable friction can be used to intelligently control coupling and positioning systems.

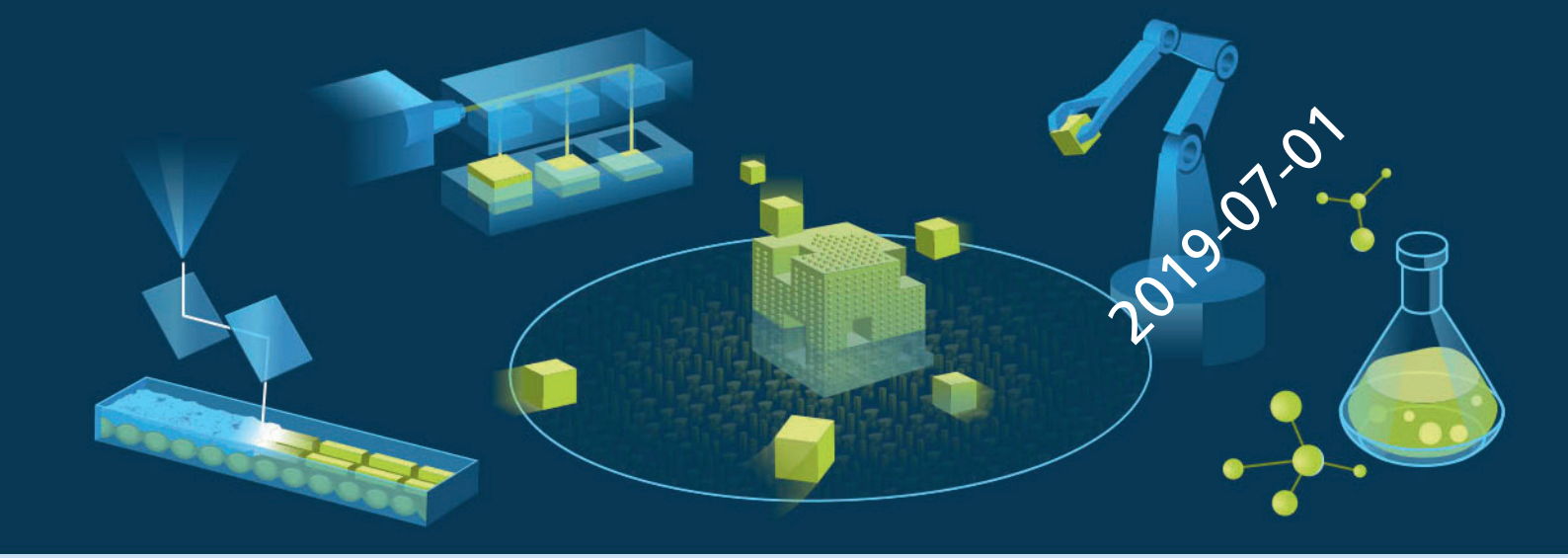
Programmable materials have the potential to initiate a paradigm shift in the design and use of materials by replacing technical systems of many components and materials with a single, locally configured one. The key to this is the programmable design of the internal structure.

The first international conference on programmable materials aims to facilitate the paradigm shift for materials science described above. It creates the interdisciplinary scientific platform to accelerate the development, production and application of programmable materials. To this end, the conference brings together scientists critical to the success of programmable materials from the disciplines of materials science, mechanics, optimization, process technology and product development and ensures their productive interaction via suitable formats, which is analogous to the integral approach inherent in programmable materials.

The conference is aimed at scientists and engineers who want to advance programmable materials with multidisciplinary contributions, who want to work on powerful tools for their realization, and who want to contribute to the paradigm shift in materials development.

Thematic priorities can be: the simulation of programmed materials, the optimization and programming of material functions, the development of suitable process technology for modular or hybrid production of programmable materials or the validation of programmable materials by demonstrators and prototypes.

With its mix of presented and submitted lectures, poster sessions and workshops, the conference offers interdisciplinary researchers and developers an ideal forum for networking and exchange regarding all relevant aspects of programmable materials.



Symposia and their focus

Optimal design of mechanical metamaterials and bionic structures

Simulation and optimization methods for synthetic porous and composite materials which exhibit unusual mechanical properties.

PD Dr. Heiko Andrä, Fraunhofer ITWM, Kaiserslautern, heiko.andrae@itwm.fraunhofer.de; Prof. Ralf Müller, University Kaiserslautern, ram@rhrk.uni-kl.de

Mechanical metamaterials

Designing adaptive shape morphing or surface properties requires us to understand, predict and optimize the complex mechanical interaction within programmable materials.

Prof. Chris Eberl, Fraunhofer IWM, Freiburg chris.eberl@iwm.fraunhofer.de

Programmable surface interactions and friction

Programming coefficients of friction into technical applications in order to stabilize a best possible operating point dynamically depending on the prevailing load collective.

Dr. Andreas Kailer, Fraunhofer IWM, Freiburg, andreas.kailer@iwm.fraunhofer.de; Dr. Tobias Amann, Fraunhofer IWM, Freiburg; Prof. Sergei Glavatskih, KTH Royal Institute of Technology, Schweden; Prof. Ian Sherrington, University of Central Lancashire, Vereinigtes Königreich

Programmable syntheses

Materials with programmed specific information, functions and/or complex structure formation patterns; synthetic protocols and design principles; applications.

Prof. Alexander Böker, Frauhofer IAP, Potsdam, alexander.boeker@iap.fraunhofer.de; Dr. Stefan Reinicke, Fraunhofer IAP, Potsdam, stefan.reinicke@iap.fraunhofer.de; Prof. Filip Du Prez, Ghent University, Belgium, filip.duprez@ugent.be

Shape memory polymers

Recent progress in the fields of synthesis, processing and additive manufacturing of shape memory polymers and the development of programming routes for one-way and in particular for two-way shape memory effects.

Dr. Thorsten Pretsch, Fraunhofer IAP, Potsdam, thorsten.pretsch@iap.fraunhofer.de; Prof. Jean-Marie Raquez, University of Mons, Belgium, jean-marie.raquez@umons.ac.be

Manufacturing and upscaling

The complexity of programmable materials (PM) exhibiting properties like predefined shape or stiffness changes requires new production processes in order to create an economic benefit.

Dr. Bernd Bader, Fraunhofer ICT, Pfintztal, bernd.bader@ict.fraunhofer.de; André Bucht, Fraunhofer IWU, Dresden, andre.bucht@iwu.fraunhofer.de

Design ideas from nature

The symposium will focus on various design principles from nature, inspiring the integration of sensoring and actuating functionalities into modern artificial materials.

Prof. Dr. Alexander Böker, Fraunhofer IAP, Potsdam, alexander.boeker@iap.fraunhofer.de; Prof. Dr. Dr.h.c. Peter Fratzl, MPI für Kolloid- und Grenzflächenforschung, Potsdam, gabbe@mpikg.mpg.de

Applications and design with programmable materials

Product ideas and visions, i.a. soft robotics and morphing structures, using programmable materials or structure-integrated functionalities, tools and methods for developing such.

Linda Weisheit, Fraunhofer IWU, Dresden, linda.weisheit@iwu.fraunhofer.de; Dr. Sylvia Schattauer, Fraunhofer, Munich, sylvia.schattauer@zv.fraunhofer.de

Chairs

Prof. Peter Gumbsch, Fraunhofer IWM, Freiburg
Prof. Alexander Böker, Fraunhofer IAP, Postdam
Prof. Chris Eberl, Fraunhofer IWM, Freiburg

Organization Team

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André Bucht, Fraunhofer IWU, Dresden
Prof. Filip Du Prez, Ghent University, Belgium
Prof. Dr. Dr.h.c. Peter Fratzl, MPI für Kolloid- und Grenzflächenforschung, Potsdam
Prof. Sergei Glavatskih, KTH Royal Institute of Technology, Schweden
Dr. Andreas Kailer, Fraunhofer IWM, Freiburg
Prof. Ralf Müller, University Kaiserslautern
Dr. Thorsten Pretsch, Fraunhofer IAP, Potsdam
Prof. Jean-Marie Raquez, University of Mons,Belgium
Prof. Ian Sherrington, University of Central Lancashire, Vereinigtes Königreich
Dr. Stefan Reinicke, Fraunhofer IAP, Potsdam
Dr. Sylvia Schattauer, Fraunhofer, Munich
Linda Weisheit, Fraunhofer IWU, Dresden

Program

5 Plenary Talks
20 Invited Talks
50 Contributed Talks
Postersession
Workshops
Panel Discussion

27 - 29 April 2020, Berlin

Contact

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More information concerning deadlines and registration will follow soon.

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