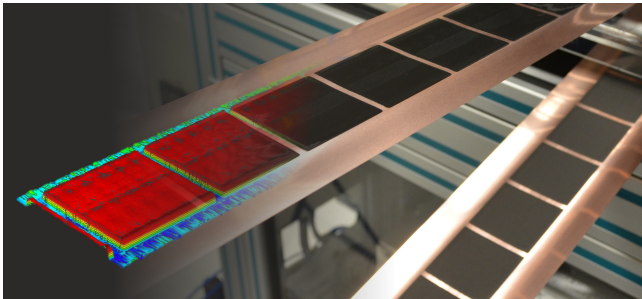




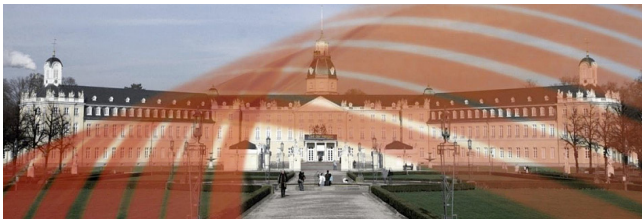
11th Short Course Coating and Drying of Thin Films

3(+2)-day short course on fundamentals and applications with practical workshop in the coating and printing lab



4th Thin Film Technology Forum

2-day forum on May 16-17 on advances in Printing, Batteries, Smart Processes & Coatings



May 13-17, 2019

KIT-Tagungszentrum (FTU)

**Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen**

Organization: Prof. Dr.-Ing. Wilhelm Schabel
Dr.-Ing. Philip Scharfer
with 24 experts from industry and academia

Program Short Course and Forum

30 contributions from 26 speakers (17 external)

Schedule 13.05.2019 – Short Course Monday

- 12:00** *Registration and hand out of course material*
- 12:30** *Welcome and introduction*
Prof. Dr.-Ing. W. Schabel / Dr.-Ing. P. Scharfer
- 13:15** *Coating and printing fluids characterisation*
Dipl.-Ing. Gilbert Gugler (iPrint, CH)
- 14:30** *Coffee break*
- 15:00** *Rheology of coating fluids*
Prof. Dr. Norbert Willenbacher (KIT)
- 16:15** *Introduction to premetered coating methods*
Dr. Peter Schweizer (Schweizer Coating Consulting, CH)

- 19:30** *Social dinner at t.b.d. (t.b.d., Karlsruhe)*

Schedule 14.05.2019 – Short Course Tuesday

- 09:00** *Special issues on curtain and slide coating*
Dr. Peter Schweizer (Schweizer Coating Consulting, CH)
- 10:00** *Coffee break*
- 10:30** *Fluid flow in coating tools*
Prof. Dr. Dr. h. c. mult. Franz Durst (FMP)
- 11:30** *Knife and blade coating*
Prof. Dr. Hadj Benkreira (University of Bradford, UK)
- 12:30** *Lunch break*
- 13:30** *Gravure and roll coating*
Prof. Dr. Hadj Benkreira (University of Bradford, UK)
- 14:30** *Coffee break*
- 15:00** *Fundamentals of film drying technology*
Prof. Dr.-Ing. Wilhelm Schabel (KIT)
- 16:15** *Coffee break*
- 16:30** *Film drying phenomena and drying studies*
Prof. Dr.-Ing. Wilhelm Schabel (KIT)

Schedule 15.05.2019 – Short Course Wednesday

- 08:30** *Drying of particulate coatings and crack formation*
Dr. Alex Routh (Cambridge, UK)
- 10:00** *Sorption equilibrium in polymeric and porous films*
Tobias Börnhorst M. Sc., Jochen Eser M. Sc. (KIT)
- 10:30** *Coffee break*
- 11:00** *Simulation & design of industrial thin film dryers*
Dr.-Ing. Philip Scharfer (KIT)
- 12:30** *Homogeneous drying with comb nozzles*
Dipl.-Ing. Philipp Cavadini (CN Drying Technology UG)
- 12:55** *Lunch break*
- 13:55** *Industrial perspectives on curtain & slot die coating*
Dipl.-Ing. Harald Döll (TSE, CH)
- 14:25** *Precise and high-speed intermittent coating*
Dipl.-Ing. Ralf Diehm (KIT)
- 14:45** *Coffee break*

- 15:15** *Coating of thin films in industrial environment*
Dr. Robert Beer (Polytype Converting AG, CH)
- 15:45** *Applications of NIR-Drying Technology*
Dr. Kai K. O. Bär (adphos Digital Printing GmbH)
- 16:15** *Coating, drying and web handling apps*
Prof. Dr. Steven Abbott (TCNF, UK)

Schedule 16.05.2019 – Short Course & Forum Thursday

- 09:00** *Experimental workshop at the TFT coating and printing laboratory*
 - Rheology & wetting
 - Pilot-scale coating trials
 - Heat and mass transfer coefficients
 - Experimental drying curves

Visit PVD Plasma Coating Lab @ IAM-AWP

12:40 TFT Forum get-together with finger food

- 13:40** *Welcome with TFT anniversary intro (2009 - 2019)*
Prof. Dr.-Ing. W. Schabel / Dr.-Ing. P. Scharfer
- 14:00** *Welcome & Introduction to KIT*
Prof. h.c. Dr. Joachim Knebel (KIT)
Head of Division 3 (Mechanical & Electrical Engineering)
- 14:10** *Presentations of TFT research highlights & discussion*
 - Marangoni flows in films (M. Tönsmann)
 - Drying of particle polymer composite films (V. Gracia)
 - Processing of perovskite PV films (S. Ternes)
 - Multilayer printing and interdiffusion in films (L. Merklein)
- 15:20** *Coffee break (with exhibition)*
- 16:00** *Advances in organic & printed electronics processing*
Ir. Ike de Vries (Holst Centre, NL)
- 16:45** *Advances in digital direct printing*
Prof. Fritz Bircher (iPrint, CH)

- 19:30** *Get-together at BESITOS (Karlsruhe town square)*

Schedule 17.05.2019 – Short Course & Forum Friday

- 09:00** *Challenges and advances in processing of battery cells*
Prof. Dr.-Ing. Arno Kwade (TU Braunschweig)
- 09:30** *Industrial production of lithium-ion battery cells*
Dr. Armin Modlinger (Volkswagen AG)
- 10:00** *Simulation approaches in mixing of battery slurries*
Prof. Dr.-Ing. habil. Hermann Nirschl (KIT)
- 10:30** *Advances in coating and drying of multilayer Li-ion battery electrodes*
Dipl.-Ing. Ralf Diehm, Jana Kumberg M. Sc. (KIT)
- 11:10** *Coffee break (with posters and exhibition)*
- 11:50** *Applications in solution-processed functional films*
Prof. Dr.-Ing. Frank Kleine Jäger (BASF SE)
- 12:20** *Shear-induced wetting phenomena of interfaces*
Prof. Dr.-Ing. Cameron Tropea (TU Darmstadt)
- 12:50** *Microfluidic and coating technology for biomedical film applications*
Prof. Dr. An-Bang Wang (NTU, Taiwan)

- 13:20** *TFT Forum closing session lunch (Finger Food)*

Introduction

The short course [Coating and Drying of Thin Films](#) addresses engineers, scientists and technicians working in the areas of coatings, functional films, direct printing, inkjet printing, sensors, adhesives, paints, automotive coatings, patches, optical foils, tapes, diagnostics, membranes, printed electronics, fuel cells and battery coatings, who intend to get insight into more fundamental aspects with industrial applications or to deepen their expertise. Leading national and international scientists and experts from academia and industry will report on topics of coating technologies, rheology, preparation of coating fluids and about fundamentals and industrial aspects of drying technology. Coating and printing processes and drying technology are explained interactively by easily accessible examples and in a [practical workshop in the TFT Coating and Printing Lab](#) instructed by TFT staff members (see photos below).

The [4th Thin Film Technology Forum](#) will take place on the 4th and 5th day, where renowned scientists will present and discuss new trends in industry and academia with a focus on [Printing, Batteries, Smart Processes & Coatings](#).



Registration fees

	Early Bird (until 01.03.19)	later
General	€ 1625.–	€ 1775.–
GVT discount	€ 1575.–	€ 1725.–
Exhibition booth (5 days)	€ 950.–	€ 1100.–

Payment

According to §4 Nr. 22a USTG the registration fee is purchase tax free. Registration fees include a short course folder with documentation of lectures and workshop, coffee, refreshments, lunch and social dinner on Monday evening and the TFT Forum get-together on Thursday evening. A participation certificate will be distributed.

Venue

The short course takes place at the KIT-Tagungszentrum (FTU), Seminarraum 157, Hermann-von-Helmholtz-Platz 1 in 76344 Eggenstein-Leopoldshafen.

Hotel recommendations

Hotel Kaiserhof, Hotel Novotel Karlsruhe City, City Partner Hotel Berliner Hof, Hotel Rio

Further information

www.thin-film-technology.de

Feedback about the last TFT courses

- “Excellent introduction in coating and drying of films. Demonstrates the complexity, offers better understanding of processes.”
- “Very interesting course, lots of information on all coating application! Building bridge from university to industrial applications.”
- “Well built-up structure, wide range of theory and application covered, too short time for discussion/break.”
- “High level talks with broad range of topics but with good scientific and practical depth, also on application.”
- “Good structure.”

and workshop

- “Good to see how the theory of the courses works in real life”
- “Experiments were very well prepared and perfectly organized”
- “Interesting, well organized”

Further information and registration:

<http://www.tft.kit.edu/745.php>
<http://www.gvt.org/Hochschulkurse.html>



Contact

Registration:

Anna-Maria Hipp: gvt-hochschulkurse@gvt.org

Phone: +49 69 7564-118

Short course organisation:

Tobias Börnhorst M. Sc.: tobias.boernhorst@kit.edu

Office TFT: margit.morvay@kit.edu





Prof. Dr.-Ing. Dr. h. c. Wilhelm Schabel (KIT) received his doctoral degree in the field of film drying. He worked as R&D engineer at Lonza High Tech Film GmbH in 2007 and was honored with esteemed awards such as Carl-Freudenberg Award 2006 by the University of Karlsruhe (TH), Arnold-Eucken Award 2007 by the VDI-GVC and the L. E. Scriven Y. I. Award 2008 by the ISCST. Within the KIT Elite Future Concept he was appointed in 2009 to the first Professorship in Thin Film Technology in Germany, financially supported by an industrial consortium of BASF, BAYER and ROCHE. In 2014 he refused a Professorship offer (W3) to TU Dresden. Since 2018 Prof. Schabel is Vice President of the new European Coating Society and in 2019 the Chairman of the next ECS Conference in Heidelberg-Karlsruhe.



Dr.-Ing. Philip Scharfer (KIT) is head of the TFT group at KIT together with Prof. Schabel. He received his PhD in process engineering from the University of Karlsruhe (TH) in 2009. Dr. Scharfer is an expert in the fields of drying and thermodynamics of thin films. He deals with measuring methods for the investigation of polymer film drying and develops numerical simulation tools for industrial dryer applications. Since 2009, Dr. Scharfer is member of the scientific committee of the European Coating Symposium (ECS), since 2012 member of the Board of Directors of the International Society of Coating Science and Technology (ISCST). In 2014, he was awarded with the L. E. Scriven Young Investigator Award by the ISCST. In 2019, Dr. Scharfer will be one of the Chairmen of the next ECS Conference in Heidelberg-Karlsruhe.



Prof. Dr. Norbert Willenbacher (KIT) is head of the Institute of Mechanical Process Engineering and Mechanics at Karlsruhe Institute of Technology (KIT) since 2004. He received his diploma degree in Physics and his PhD from the University of Mainz. After his dissertation at the Max-Planck-Institute for Polymer Research he joined BASF SE as a research associate in the fields of rheology of complex fluids and adhesion of soft polymers for 15 years. Prof. Willenbacher is president of the German Society of Rheology, assigned member of the ProcessNet Technical Committee on Rheology, and member of the Editorial Board of Rheologica Acta.



Prof. Dr. Alex Routh (Cambridge University, UK) received his PhD from Princeton University in the US in 2000. He has been lecturing in Chemical Engineering at the University of Cambridge since 2006 and was promoted to full professor in 2017. His position is a joint appointment with the BP Institute for Multi-Phase Flow, a multi-disciplinary research institute within the University, spanning the physical sciences. His research is in the field of colloid science and Prof Routh has worked in the areas of encapsulation, dispersion stability, formulation and drying. Within the film drying topic, he has been active for the past 15 years and has published extensively in the specifics of film cracking and the flows within thin films.



Dipl.-Ing. ETH Gilbert Gugler (iPrint, CH) received his diploma in material science from the ETH Zurich in 1992. From 1992 to 1998 he worked in the area of chemical and physical vapour deposition. From 1998 on, he worked at Ilford Imaging Switzerland GmbH. Leading the Technology Center of Wifag-Polytype Technologies AG since 2014 he was responsible for all coating and process related topics. End of 2016 he joined the university of applied science and arts of Western Switzerland as deputy managing director of the iPrint institute. Gilbert Gugler is an expert in multilayer curtain coating technology, starting from the preparation of coating fluids, characterization, processing, to the multilayer curtain coating and drying. Since 2017, he is heading his own company called Gugler Coatech Consulting.



Dr. Peter M. Schweizer (Schweizer Coating Consulting, CH) received his PhD in Mechanical Engineering from the Swiss Federal Institute of Technology in 1979, and he did postdoctoral research in coating flows at the University of Minnesota with Prof. Scriven from 1979 – 1980. From 1981 – 1986, Dr. Schweizer worked in the Coating Flow Research Group at Kodak in Rochester, New York, and from 1987 – 1996, he worked at ILFORD in Fribourg, Switzerland. From 1997 – 2000, Dr. Schweizer was Managing Director of TSE Troller Schweizer Engineering in Switzerland. From 2001 – 2016, he worked for Polytype Converting in Fribourg, Switzerland. Since 2016, he is heading his own company called Schweizer Coating Consulting GmbH.



Prof. Dr. Hadj Benkreira (Univ. of Bradford, UK) (BEng, MSc Chemical Engineering) obtained his PhD on the Fluid Mechanics of Coating Flows in 1980 under the supervision of Professor WL Wilkinson (CBE, FRS). Following five years of EPSRC postdoctoral research, he joined the academic staff of the University of Bradford in 1985 and was endowed a Personal Research Chair in 1998 for research in Thin Film Coating and in Polymer Processing and became in 2004-2009 Associate Dean for Research. Professor Benkreira is member of several learned societies including the UK EPSRC Peer Review College, the ISCST of which he was the Vice President in 2006-8 and the European Coating Symposia steering committee. He has published widely on coating science and technology and is the editor of the Special Issues of the ISCST conferences.



Prof. Dr. h. c. mult. Franz Durst (FMP TECHNOLOGY GMBH) graduated from Imperial College at the London University and received his doctor's degree in 1972 (PhD). In 1972, he returned to Germany and worked as subproject leader of various research projects at the Collaborative Research Center 80 at the University of Karlsruhe for ten years. Prof. Durst was offered a C3 professorship for Fluid Mechanics at the University of Karlsruhe in 1978 and was appointed chair of the Institute of Fluid Mechanics at the University of Erlangen-Nuremberg in 1982. In 2006, Prof. Durst retired from the University of Erlangen-Nuremberg and founded the company FMP TECHNOLOGY GMBH, whose CEO he has been until 13 August 2018. He is now still one of the two shareholders of the company.



Dipl.-Ing. Philipp Cavadini (CN Drying Technology UG) graduated in Aerospace Engineering at the University of Stuttgart. In his PhD studies at KIT/TFT until 2015 he investigated surface tension driven convection and the optimisation of impinging jet systems from the viewpoint of homogeneity of the distribution of the heat and mass transfer coefficient. Currently Mr. Cavadini works on cooling technologies in the department of "Methods and Technology" at Siemens Energy. In secondary employment, he is working on the spin-off creation "CN Drying Technology UG", developing highly homogeneous comb nozzle dryers for lab application.



Dr. Robert Beer (Polytype Converting AG, CH) completed his PhD in physical chemistry in 1988 at the University of Berne. After a postdoctoral stay at the Loughborough University of Technology, he returned to the University of Berne continuing the studies in photophysics and photochemistry as scientific assistant. From 1992 to 2014 he was working at Ilford Imaging GmbH in Switzerland, starting in R&D. From 2006 he moved to the process technology department, engaging himself in the curtain coating technology and production scale up. After 2014, Robert Beer increased his competence in coating technology at Polytype Converting AG and since 2016 he is co-heading the Technical Center.



Dr. Kai K. O. Bär (adphos) is the Managing Director/ President of the adphos Digital Printing GmbH. He was one of the founders of the IndustrieSerVis GmbH (legal predecessor of AdPhos). Before he was the leader of the business segment "High Temperature Technology and Installations" at IABG, Ottobrunn. Dr. Bär was responsible for the Technology-Program "HERMES-Heatstructure-Tests" and graduated as Dr.-Ing. (with award) at the RWTH Aachen in Germany.



Prof. Dr. Steven Abbott (TCNF, UK) received his Oxford PhD in Chemistry from Harvard University in 1978 and was postdoc in the Nobel Prize winning lab of Prof. J.-M. Lehn in Strasbourg before working for ICI where he was Senior Manager before joining the high-tech coating company Autotype near Oxford as Research Director. He worked closely with coating experts at U. Leeds (appointed Visiting Professor in 2000) and co-created the TopCoat and TopWeb programs for the coating industry. He now teaches, consults and troubleshoots around the world on coating, solubility, surfactant and adhesion science, using his own apps and software to bring science to life.



Dipl.-Ing. Harald Döhl (TSE, CH) successfully graduated from the Technical University in Darmstadt in Mechanical Engineering in 1989. After some year in web-guiding systems Harald Doell joined TSE Troller AG in 1997. In the beginning, he was the head of the engineering team; since 2008, he is in charge of the entire application technology. Design of die internals, experiments with customers, start-ups and technical customer support are part of his assignment. Furthermore, he is giving talks at several short courses and international conferences in the US, Europe and Asia.

Additional speakers at the 4th TFT Forum on May 16-17



Ir. Ike de Vries (HOLST CENTRE, NL) studied Chemistry and Agricultural Science at the Wageningen University, Netherlands. After graduation in 1985 he was for a period of 3 years a researcher at the Wageningen University. From 1988 to 2006 Ike de Vries was a project leader and process/research engineer in the field of extrusion coating and substrate development for ink jet and photographic paper at Fuji Photo Film. Since 2006, he is a research scientist at the Holst Centre Institute in Eindhoven, The Netherlands. Inventing and developing new (R2R) processes and slot die coating technologies, especially intermittent coating, are his main core competences. This to enable large scale production for flexible electronics, like for example organic light emitting diodes (OLEDs) and photovoltaic (PV).



Prof. Fritz Bircher (iPrint, CH) studied electrical engineering at ETH Zurich. After graduating he worked as R&D engineer for different companies developing mechatronic system solutions. In 1993 he was appointed professor at Bern University of Applied Sciences, where he started his research in inkjet printing, studying and exploring all possible jetting and dispensing principles with all kinds of materials in a wide range of applications. In 2012 he joined the University of Applied Sciences Western Switzerland in Fribourg, where he founded iPrint institute and iPrint Center for Digital Printing on the Marly Innovation Center. Fritz's main research interests based on inkjet printing include: packaging printing, direct-to-shape printing, material printing including 3D printing and bio printing.



Prof. Dr.-Ing. Arno Kwade (TU Braunschweig) graduated from the Institute of Mechanical Engineering, Technische Universität Braunschweig and received his doctor's degree (PhD) in 1996. Until 2005, he was Executive Director of Betonwerke Emsland GmbH and Kwade+Schweddes Zerkleinerungstechnik. He is Professor at Technische Universität Braunschweig, head of the Institute for Particle Technology and one of the founders of the BLB (Battery lab Braunschweig). Prof. Kwade is a leading expert in battery processing technology, coordinator of the BMBF cluster "ProZell" and initiator of the annual International Battery Production Conference (IBPC).



Dr. Armin Modlinger (Volkswagen AG) graduated in Chemistry at the University of Bayreuth in 2000, followed by a doctoral degree in 2004 at the Technical University Munich. After a Postdoctoral fellowship at the University of Bristol he started his career in the chemical industry at Evonik Industries in 2006, working at different positions in R&D departments associated with Lithium-Ion Technology. 2013 he became head of process technology at Litarion GmbH and later in 2017 he took over responsibility for Product and Process Development at Litarion GmbH. In April 2018 he joined the Center of Excellence Batteriezelle within the Volkswagen Group.



Prof. Dr.-Ing. habil. Hermann Nirschl (KIT) received his Ph.D. in Fluid Mechanics from the Technical University of Munich in 1994. For his Habilitation in 1997 he worked on the numerical simulation of the particle laden flows. He joined the 3M company in the dental division as the head of process engineering in the years between 1997 and 2002 where he worked as a project manager for different projects in Munich and St. Paul/Minnesota. Since 2003 he is Professor for Mechanical Process Engineering at the KIT in Karlsruhe. The focus of the research is on particle technology with a special emphasis on separation processes, numerical simulations and the development of particle analysis technologies.



Prof. Dr.-Ing. Frank Kleine Jäger (BASF SE) is currently Senior Research Manager and Head of Solids Formulation and Handling Group at BASF SE in Ludwigshafen. In this role, he manages the global R&D activities in this field of Solids and Film Processing ranging from development of new process technologies and optimization to trouble shooting and debottlenecking in BASF's global production plants. He is Chemical Engineer with Diploma and PhD degrees from RWTH Aachen University, Germany. He also received his Habilitation from RWTH Aachen in 2004. Since 2011 he holds a Professorship as apl. Prof. Dr.-Ing. at RWTH Aachen.



Prof. Dr.-Ing. Cameron Tropea (TU Darmstadt) graduated from the University of Toronto in Engineering Sciences, followed by a Masters degree in Mechanical Engineering (1977). He completed his Dr.-Ing. in Civil Engineering at the Technical University of Karlsruhe (1982) and his Habilitation in Fluid Mechanics at the University of Erlangen-Nürnberg (1991) where he was appointed as Professor of Fluid Mechanics until 1997.

This was followed by an appointment to his current position at the Institute of Fluid Mechanics and Aerodynamics at the TU Darmstadt. Currently Editor-in-Chief of the Springer journal Experiments in Fluids and past Director of the Center of Smart Interfaces (CSI) in the period 2007-2014, his research interests include Optical Measurement Techniques in Fluid Mechanics, Interfacial Transport Phenomena, Atomization and Spray Processes and Unsteady Aerodynamics. He has recently been appointed a member of the Scientific Commission of the Council of Science and Humanities in Germany.



Prof. Dr. An-Bang Wang (NTU, Taiwan) received the Dr.-Ing.-degree at the Institute of Fluid Mechanics (LSTM), University of Erlangen-Nürnberg, Germany in 1991 and is a full professor at the Institute of Applied Mechanics, National Taiwan University (NTU), Taiwan. He has served as the director of Optomechatronics Education Resource center, chairman of the display technology Education Program and counselor of advisory office, Ministry of Education, Taiwan; vice president of International Society of Coating Science and Technology. He was honored with the Distinguished Engineering Professor Award of Chinese Institute of Engineers, Taiwan. His current research interests include advanced coating & microfluidic platform for biomedical/industrial applications and biomimetics.

A total of 26 speakers, including 17 external and following PhD students of the TFT group at KIT:



Dipl.-Ing. Anna-Lena Walz completed her studies in Chemical Process Engineering at KIT in 2012, majoring in Thermal Process Engineering and Technical Thermodynamics. She conducted her diploma thesis as a Solvay scholarship student at the University of British Columbia in Vancouver where she investigated the formation of polymer stabilized nanoparticles for drugs applications. Further, a scholarship was granted her by the German National Academic Foundation during her studies. Since 2013 she is working as research assistant at the KIT/TFT. In her PhD she focuses on processing biosensor solutions, in particular on their special treatment during coating and drying due to sensitive components, on their sorption behavior as well as on the development of novel biosensor solutions containing conductive polymers.



Dipl.-Ing. Ralf Diehm graduated in Process Engineering at KIT in 2014, majoring in Thermal Process Engineering and Chemical Energy Sources. Already during his studies he started to specialize on thin film coatings of organic electronics in his student research project and of lithium-ion battery electrodes in his diploma thesis. Since 2014 he is working as research assistant at the KIT/TFT group, focussing on stability and mechanism of slot die coating and in particular of intermittent coating to provide a fundamental understanding of the process and its limitations. In 2015 he was awarded with the first prize of the KIT "Neuland" award for his innovations in high speed intermittent slot die coating.

Additional speakers and workshop instructors



Tobias Börnhorst
(since 2015)



Jochen Eser
(since 2015)



Max Tönsmann
(since 2015)



Lisa Merklein
(since 2016)



Jana Kumberg
(since 2016)



Victor Gracia
(since 2017)



Sandro Spiegel
(since 2017)



Andreas Altwater
(since 2018)