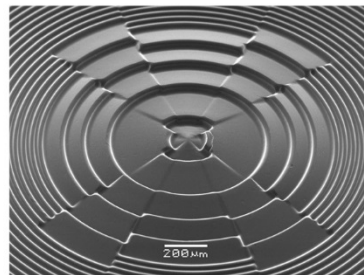
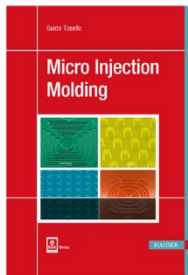
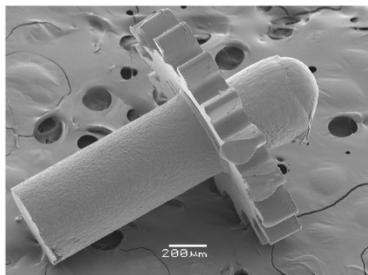


MICRO NANO MOLDING SEMINAR, BOOK RELEASE & RECEPTION

Technology and Applications

December 5th, 2018, 08:30-17:00

Technical University of Denmark, DTU Lyngby,
Building 101, Meeting Center, 1st floor, Meeting room 1
Anker Engelunds Vej 1, DK-2800 Kgs. Lyngby (Denmark)



**Register and get a free copy of the new book 'Micro Injection Molding'
published in August 2018 by Carl Hanser Verlag**

Working with injection molding? Tools production? Product development? This seminar will give you the opportunity to stay up to date with the latest developments in precision micro injection molding (μ IM), including: micro molding product development and industrial production, process monitoring and simulation, tooling technologies, additive manufacturing, quality control, metal/ceramic/2k micro molding.

During this unique 1-day conference, the book 'Micro Injection Molding' will also be presented in a worldwide première. We have gathered the leading micro molding experts and main authors of the 'Micro Injection Molding' book chapters as well as key-players from the micro molding industry to share their knowledge and expertise for successful μ IM.

To celebrate the release of the book (just published in August 2018 by Carl Hanser Verlag) and its official presentation at this unique seminar, you will receive a complimentary copy of the brand new book 'Micro Injection Molding' kindly sponsored by Ortofon A/S (Denmark).

Registration, full program, and list of speakers available at: <https://atv-semapp.dk/micro-nano-molding-seminar/>

Read more information about the 'Micro Injection Molding' book at: <https://www.hanser-elibrary.com/doi/book/10.3139/9781569906545> and <https://www.hanserpublications.com/Products/504-micro-injection-molding.aspx>

Download a 30 pages free preview of the 'Micro Injection Molding' book at:
http://files.hanser.de/Files/Article/ARTK_LPR_9781569906538_0001.pdf

MICRO NANO MOLDING SEMINAR

December 5th 2018 at Technical University of Denmark

SPEAKERS



Guido Tosello, PhD
Associate Professor
Tech. Univ. of Denmark



Oltmann Riemer, Dr.-Ing.
Head of Department, Leibniz
Institute Material Science (Germany)



Christen Nielsen, CEO
Ortofon Microtech
(Denmark)



Volker Ptotter, Dr.-Ing.
Head of Materials and Processes
Karlsruhe Inst. of Tech. (Germany)



Christian Griffiths, PhD
Senior Lecturer
Swansea University (UK)



Giovanni Lucchetta, PhD
Associate Professor
University of Padova (Italy)



Ben Whiteside, PhD
Director
Polymer MNT Centre (UK)



Ali Davoudinejad, PhD
Post Doctoral Fellow
Tech. Univ. of Denmark



Giuliano Bissacco, PhD
Associate Professor
Tech. Univ. of Denmark



Aminul Islam, PhD
Associate Professor
Tech. Univ. of Denmark



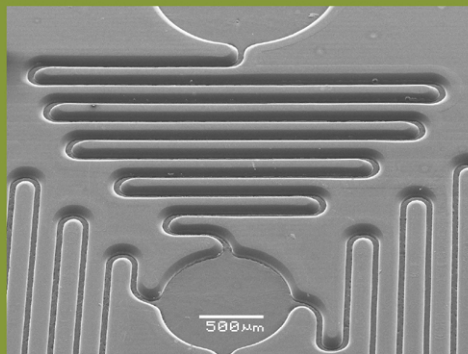
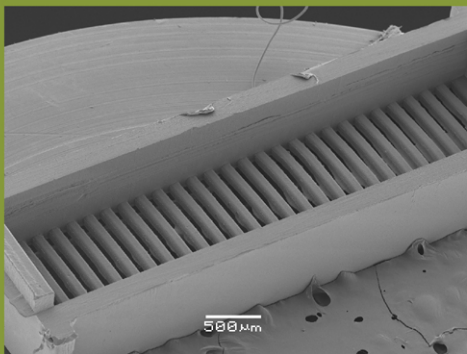
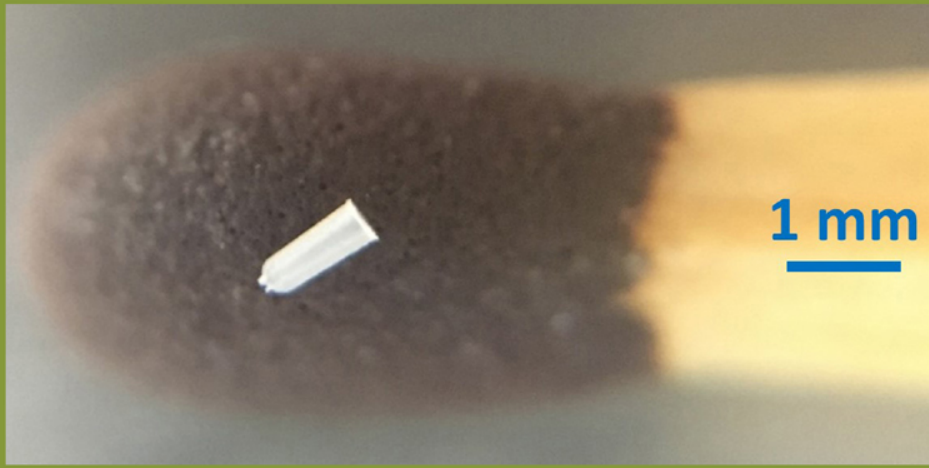
Danilo Quagliotti, PhD
Post Doctoral Fellow
Tech. Univ. of Denmark



Matteo Calaon, PhD
Researcher
Tech. Univ. of Denmark

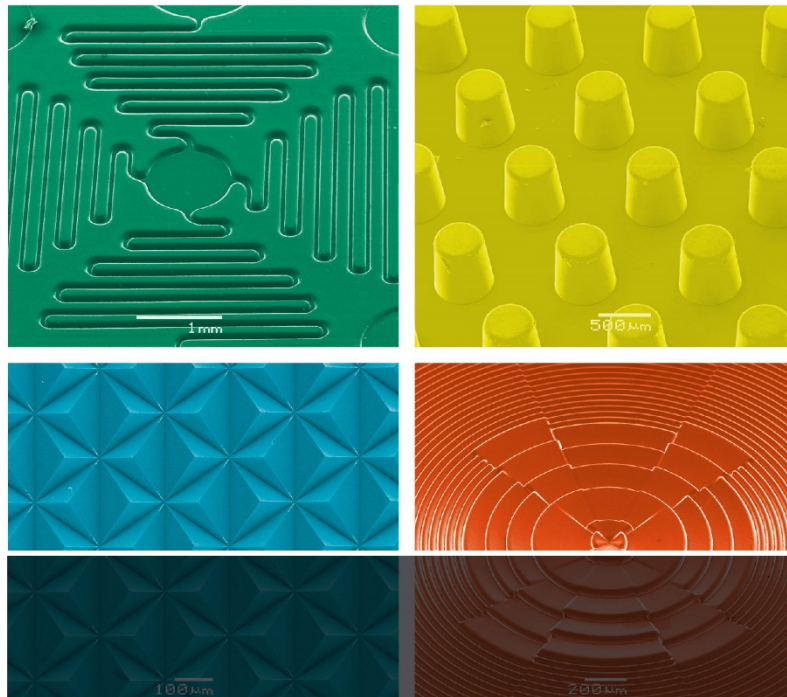


Gualtiero Fantoni, PhD
Associate Professor
University of Pisa (Italy)



Guido Tosello

Micro Injection Molding



Bonus

HANSER

5 December 2018

DTU Lyngby

Meeting room 1

Anker Engelundsvej 1

2800 Kgs. Lyngby

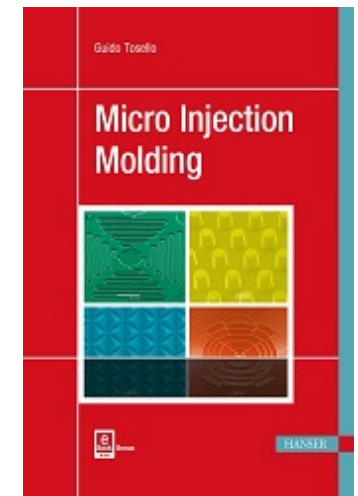
Micro moulded parts are characterized by dimensional tolerances in the micrometer range, high surface finish in the sub- μm down to optical range and high geometrical complexity. High demands of micro moulded parts is seen from the medical, healthcare, automotive and electronics sectors. The global market of micro injection moulding is expected to reach USD 1 billion by 2020.

The book 'Micro Injection Molding', published in August 2018 by Carl Hanser Verlag (Munich, Germany), meets the needs to overcome the challenges of successfully managing and processing polymer materials at ultra-small scales.

The book will be presented in world exclusive at this seminar and each participant will receive a complimentary copy sponsored by Ortofon.

The world's leading micro moulding experts from industry, research institutes and universities have contributed to the book and will present different key topics about the technology at this seminar: polymer material and process micro technology, tooling technologies for micro mould making, micro moulding key-enabling technologies and multi-material micro processing.

This seminar will be of high interest for engineers, researchers, project managers, consultants and professionals involved in precision polymer processing, micro manufacturing, new product development and tool production.



08:00 - 08:30 **Registration**

08:30 - 08:40 **Welcome and Seminar Programme Introduction**

Guido Tosello, Associate Professor, DTU Mechanical Engineering, DK

Guido Tosello's is the Editor of the book 'Micro InjectionMolding' (Hanser, 2018). He is the co-founder of the 'ATV-SEMAPP MICRO NANO MOLDING SEMINAR - Technology and Applications' series started in 2010.

**08:40 - 08:55 Micro Injection Molding - a practical experience**

Christen H. Nielsen, CEO, Ortofon A/S, DK

In the last few years, Ortofon has greatly expanded its know-how and technological understanding of micro injection molding, in particular with respect to the frontiers of dimensions and tolerances achievable in plastic micro component production. This presentation will focus on the latest micro moulding developments, the integration of micro injection technology into micro mechanical assembly, and the achievement of micro tolerances on plastic parts with mass in the milligram range.

Christen H. Nielsen holds a degree in economics and languages. Christen has worked with management and held executive positions in technical companies. Since 2004, he has worked as a CEO and partner at Ortofon with a focus on innovation and technology development.

**08:55 - 09:20 Micro Injection Molding Machines Technology**

Gualtiero Fantoni, Associate Professor, University of Pisa, IT

Micro and nano injection moulding is one of the hottest technologies since its numerous applications apply in different fields. This talk analyses the evolution from two perspectives: patents and design. The first part analyses how and where the machines are developed and process investigated giving the audience a general feeling on how the research and the applications are evolving worldwide. The second part investigates how micro injection moulding machines are designed, what are the principles and what were their evolution from macro to micro. The analysis is based both on a theoretical functional analysis and on the performance of different injection moulding machines. This talk starts with the machine main part features description associated with process phases and functions. Subsequently part features are analyzed to understand the causal chains bringing either to the desired behavior or to the failure to be avoided. Finally, design solutions are compared by gathering quantitative data from experiments.

Gualtiero Fantoni's main research interests are micro assembly and manufacturing, grippers and feeders. His research activities do not only include technologies, applications and tests, but also design. Fantoni is involved also with two spin off companies - one working with technical texts analysis and the other with Industry 4.0 data acquisition from industrial machines.

09:20 - 09:45 Micro Moulding Process Monitoring and Control



Ben Whiteside, Director, *University of Bradford, UK*

Accurate process monitoring is a key requirement for any industrial process and provides information that can be used to identify issues and control the process within acceptable limits to guarantee output quality.

The micro injection moulding process poses key measurement challenges for the implementation of such systems and the work presented here shows how these challenges can be overcome through a combination of prudent technology selection and design. A number of different sensor technologies and applications will be presented, along with strategies for Industry 4.0 compliant systems.

Ben Whiteside is the Director of the RKT Centre for Micro and Nano Technology at the University of Bradford. His research creates new manufacturing routes for ultra-precision devices using a wide range of polymer-based materials. Application areas include medical devices, optics and mechanical components.



09:45 - 10:15 **Break**

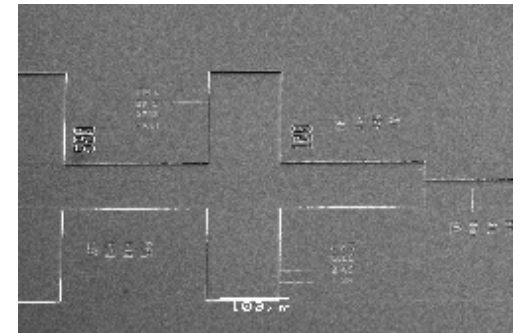
10:15 - 10:40 **Surface Replication of Micro and Nano Structures**



Matteo Calaon, Researcher, *DTU Mechanical Engineering, DK*

Innovation in nanotechnology proposes applications integrating micro and nanometer structures fabricated as master geometries for final replication on polymer substrates. This presentation highlights developed methods and approaches to process chain validation for final polymer micro and nano structures replication. Fidelity between the different process chain steps and their dependency to process variation, process conditions, tool accuracy, material behavior and features geometries are presented.

Matteo Calaon's main activity areas cover precision manufacturing for final polymer micro and nano structures replication, process chain characterization and calibration for advance manufacturing through surfaces and dimensional metrology, design and product development oriented to industrial production.



10:40 - 11:05 **Micro Machining Technologies for Micro Injection Mould Making**



Giuliano Bissacco, Associate Professor, *DTU Mechanical Engineering, DK*

Giuliano Bissacco is Associate Professor of Tooling Technologies at the Department of Mechanical Engineering of DTU. He has more than 15 years of research experience in micro and precision manufacturing. He is lecturer of micro and precision machining and process chains at DTU Mechanical Engineering and responsible of the DTU PhD Summer School on Micro Manufacturing.

11:05 - 11:30 **Ultra-Precision Machining Technologies for Micro Injection Mold Making**



Oltmann Reimer, Head of Department at Laboratory for Precision Machining , *University of Bremen, DE*

In this contribution, the variety of machining processes from diamond turning w/ or w/o Fast Tool Servos, ultra-precision milling and diamond milling, shaping processes like Diamond Micro Chiseling for structured optical surfaces as well as abrasive machining like precision grinding, micro grinding and polishing techniques will be introduced. The application of these machining technologies to the fabrication of optical molds is elucidated by selected examples like such as a Fresnel lenses, a micro beam splitter and retroreflectors.

Oltmann Riemer is the head of the Laboratory for Precision Machining (LFM) at the University of Bremen and the Leibniz Institute for Materials Engineering (IWT). The focus of his research work is in the area of ultra-precision machining processes, cutting mechanics, micro machining technologies and microtopography characterisation.



11:30 - 11:55

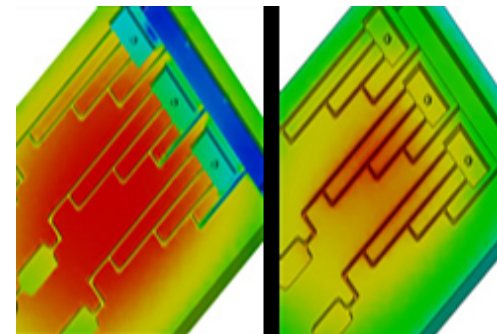
Surface Treatment of Mould Tools in Micro Injection Moulding



Christian Andrew Griffiths, Senior Lecturer, *Swansea University, UK*

Mass manufacture requires robust replication technologies to meet these demands and microinjection moulding is a key technology for achieving micro-parts in large-scale production. The high performance micro moulds used in the moulding process are critical for delivering high quality parts for the duration of the product life cycle. Tool coatings are commonly used to improve the life of large scale moulds, and recently Diamond-like carbon (DLC) coatings have been shown to enhance the performance of micro moulds. This talk will discuss novel surface treatments used in micro injection moulding to improve the factors that affect parts' quality and to increase part functionality. Christian will discuss various surface treatments and their influence regarding the behaviour of the μ -IM process and identify novel surface treatments for texturing micro mould tools.

Christian Andrew Griffiths is a Senior lecturer at Swansea University. The main focus of his teaching activities are in manufacturing and he is the Director of the AIRBUS BEng and FEngd Aeronautical and Manufacturing Engineering degree schemes. Christian's overall research interest lies in the field of Micro and Nano technology and his recent research has been focused on Robotics and Automation, 3D printing and characterisation of micro scale polymer flow behaviour at the melt/tool interface using novel condition monitoring techniques.



11:55 - 12:50

Lunch

12:50 - 13:15

Vacuum-Assisted Micro Injection Molding

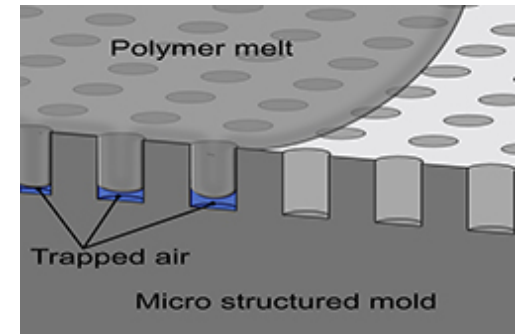
Giovanni Lucchetta, Associate Professor, *University of Padova, IT*

Vacuum-assisted micro injection molding has been established as a common practice for the manufacturing of micro- and nano-structured surfaces, where the adoption of conventional passive evacuation setups (i.e., machined slots) is not possible. The vacuum venting



application is introduced in the conventional process as an auxiliary technology that allows improvement of the replication degree by reducing the counteracting pressure generated by the air entrapped in micro features. Evacuation of air from the cavity has been reportedly observed to provide significant advantages for the quality of the molded micro parts, the integrity of the tool and the controllability of the process. However, disadvantages could be increased cycle time and costs. The effects on part quality resulting from the application of vacuum venting is evident. The effect on the replication degree of micro features is however more complex. During its optimization other variables such as the selection of different process parameters and of the molding polymer should be considered.

Giovanni Lucchetta's main research interests are on injection molding and micro technologies with particular reference to micro injection molding. Research topics include precision injection molding of aesthetic components, micro injection molding, injection molding of bonded magnets and the processing of fiber reinforced plastics.



13:15 - 13:40

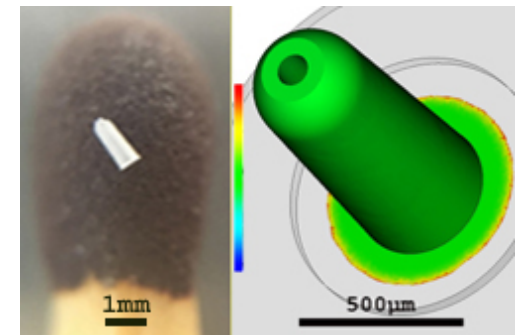
Latest Developments in Micro Injection Moulding Simulation



Guido Tosello, Associate Professor, DTU Mechanical Engineering, DK

Recent research carried out at DTU Mechanical Engineering has shown that today it is possible to use simulation of micro injection moulding to analyze and improve micro part design, micro tool design and process design. Advances in micro moulding optimization and application to micro structured components (weight > 100 mg) and micro 3D components (weight <10 mg) for applications in the medical industry will be presented during this talk.

Guido Tosello has 10+ years of research experience in the analysis, characterization, monitoring, control, optimization and simulation of precision molding processes at micro/nano scales of thermoplastic materials. Guido is the recipient of the "Technical University of Denmark Best PhD Research Work 2008 Prize" for his PhD thesis "Precision Moulding of Polymer Micro Components" and the Project Coordinator of the EU H2020 project MICROMAN 'Process Fingerprint for Zero-defect Net-shape MICROMANufacturing' involving 30 researchers and 23 partners in 9 European countries (<http://www.microman.mek.dtu.dk/>).



13:40 - 14:05

Metrological Quality Assurance in Micro Injection Molding

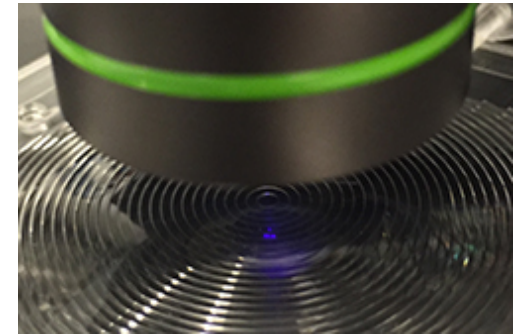


Danilo Quagliotti, Postdoc, DTU Mechanical Engineering, DK

Nowadays, moulding technologies are still leading in the mass production of new advanced micro and nano systems, involving large varieties of materials, different dimensional scales, increasingly small dimensions and dramatic growing of the complexity of the surfaces, which incorporate more and more functionalities in one single micro- or nano-structured part. In this perspective, metrology must provide adequate instruments and techniques for quality assurance and concurrently the possibility to efficiently cope with industry requirements.

This presentation covers comprehensive techniques for the evaluation of micro injection moulding productions introduced through several actual cases from recent research. Several working principles of instruments to be used for measuring micro injection moulded components are also presented, including scanning probe microscopes, coordinate measuring systems and computed tomography scanners.

Danilo Quagliotti has 12+ years' experience in metrology gained initially at INRIM, the Italian National Metrology Institute and successively, at the Technical University of Denmark. He is currently researching in the field of metrology for micro and nano manufacturing, focusing on statistical techniques for uncertainty evaluation and quality assurance.



14:05 - 14:35 **Break**

14:35 - 15:00 **Micro Additive Manufacturing and Integrated Process Chains for Micro Moulding Production**



Ali Davoudinejad, Postdoctoral Researcher, DTU Mechanical Engineering, DK

The direct fabrication of miniaturized polymer components by Additive Manufacturing (AM) processes is a remarkable method at the micro dimensional scale. Injection molding inserts manufactured additively by vat photopolymerization has become a serious option for significantly faster and more economical prototyping and pilot production due to technological progress and advancements in photopolymer materials in recent years.

This talk discusses the latest development related to additive manufacturing used for tolling manufacture in micro injection moulding. In particular dimensional variation of moulded features geometries and corresponding structures on the printed tool are presented. Dimensional accuracy in investigated linking toll wear with the increasing micro injection moulding process cycles.

Ali Davoudinejad is a Postdoctoral Marie Skłodowska Curie researcher on Micro Additive Manufacturing and Integrated Process Chains at DTU. Ali holds a PhD in mechanical engineering on precision micro milling and numerical modeling of the process at the Politecnico di Milano, IT.

15:00 - 15:25 **Development and Utilization of Micro Powder Injection Molding (MicroPIM)**



Volker Pötter, Head of Process Development Unit at the Institute for Applied Materials, Karlsruhe Institute of Technology (KIT), DE

Miniaturization of technical components represents an eminent trend of our time and many Micro System Technology (MST) products made of polymers or silicon have successfully entered the market. On the other hand many applications demand for higher specific properties, i.e. the metal and ceramic materials and adequate manufacturing processes. Due to this constellation, the development of the so-called MicroPIM process for the fabrication of metal and ceramic micro components was an obvious concern. The smallest details in the micrometre range have been achieved using different kinds of metal (steel, iron alloys, copper, tungsten etc.) and ceramic powders. The powder particle size has been identified as one of the most influential factors



concerning surface quality and accuracy. The powder-binder segregation is mainly caused by the occurring shear rates and can be regarded as the main reason for failures such as voids and distortion. Up to a certain extent, however, simulation of flow filling might help to avoid such defects. By way of further progress in micro-manufacturing, two-component and in-mold-labeling MicroPIM has been developed. Both variants allow for the fabrication of multi-material and thus multi-functional products with the additional benefit of reduced assembly costs.

Volker Pötter is heading the Process Development Unit of the Institute for Applied Materials at KIT. He obtained his PhD at Berlin Technical University in 1993 and joined KIT after spending nearly two years in a polymer engineering company. Volker Pötter is a member of the German Expert Groups for Metal and Ceramic Injection Moulding.

15:25 - 15:50 **Multi Material Micro Injection Molding**



Aminul Islam, Associate Professor, DTU Mechanical Engineering, DK

The continuous trend towards miniaturization and multi-functional products calls for more and more multimaterial components for the future micro systems. The multimaterial and functionally integrated products are becoming in most cases an economic and technological key factor for the advanced micro systems. One of the most industrially feasible ways to produce multicomponent micro parts is the multimaterial micro moulding. By merging of shaping and assembly processes into a single step in multimaterial (also known as multicomponent) moulding, a significant economic progress can be made in micro manufacturing.

This presentation will focus on the different aspects of multimaterial micro injection moulding. Special emphasis will be given to the two component micro injection moulding as this is the basic process of multicomponent micro injection moulding. The focuses will be on the parameters that influence the quality of polymer-polymer bonding interface. The presentation will introduce the analyses and relations between the bonding and the interface quality with special focus on micro scale applications. The results and discussion presented will provide a guideline for the multicomponent micro moulding for a wide range of industrial applications.

Aminul Islam is a specialist in multi-material micro manufacturing with 15 years' experience of a unique mix of research in both industry and academia. His research interests comprise advanced material processing, multi-material micro moulding, micro powder moulding, moulded interconnect devices (MIDs), hearing aid technology and components.

15:50 - 16:00 **Closing Remarks**

16:00 - 17:00 **Reception sponsored by Saxe Group**

Micro Nano Molding Seminar, 5 December 2018

Seminar: *

Micro Nano Molding Seminar, 5 December 2018



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Registration fee

Members of ATV-SEMAPP or other promoting organizations: DKK 2,150

Non-members: DKK 2,775

M.Sc. students: DKK 200 & Ph.D. students: DKK 975 (Membership is free of charge. Early bird discount does not apply)

Early bird discount of DKK 200 when registering before 20 November 2018

All prices are excluded of Danish VAT.

The fee includes talks, breakfast, lunch, coffee breaks and reception.

Cancellation

Cancellations received before 26 November 2018 are fully refunded. No refund for cancellations received on 26 November or later, nor for being unable to attend on the day. Substitutions are accepted at any time.

Questions

Please do not hesitate to contact ATV-SEMAPP by e-mailing semapp@atv-semapp.dk or phoning Jytte Laursen +45 4525 4898 or Charlotte Leser +45 4525 4899.

