mAm 2018

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EAB MEMBER

Following the success of eight annual editions of mAm (the Micronarc Alpine Meeting), the ninth was again held at the Eurotel Victoria hotel, in idyllic Villars-sur-Ollon, a ski resort village located at 1,250 m altitude in the Swiss Alps. It gave participants spectacular panoramic views extending from Lake Geneva to Mont-Blanc and easy access to the ski centres.

The organisers—Micronarc and MANCEF—with help from their media partners, Commercial Micro Manufacturing (CMM), Eurotec and MSM, were pleased to attract 77 participants, including a total of 18 sponsors and exhibitors. As well as the high-level technical programme, the continuing popularity and support of this annual meeting can be attributed to the quality of the networking and the casual atmosphere for discussion not offered by the larger and more formal conferences. mAm is the most successful of MANCEF's COMETS (Commercialisation of Emerging Technologies) sector-specific conferences.

This year, the technical programme continued with its emphasis on microproducts and micro-manufacturing, with keynote speakers addressing current and future developments. Single track sessions over two days included dedicated talks on micro-manufacturing applications and products in medical technologies, watchmaking, sensors, energy systems and 3D printing. Watchmaking and medical technologies were included since they are important sectors of local Swiss industry.

Microsystem- and microelectromechanical-(MEMS-) based products are now in the age of high-volume production for consumer applications, especially mobile phones, information and communications technology (ICT) and customised medical devices, a large proportion of which are based on sensors. These are the ubiquitous products in the Internet of Things (IoT) and autonomous systems, which are key elements of the fourth industrial revolution—otherwise referred to as 'Industry 4.0'. The fast-growing market for such components and products is now estimated to be heading towards trillions of dollars or euros.

The issues associated with the production of these are of continuing interest to manufacturers. These include tooling in high-volume fabrication of precision parts, making highly efficient and reliable automated assembly lines and test systems for microproducts.

▶ The mAm 2018 conference in the Eurotel Victoria meeting room. ▶

▶ *The co-located tabletop exhibition.* ▶

The traditional evening dinner for the mAm was held at the Golf Villars restaurant, 1,600 m up a snow-covered mountain. Participants walked along a snowy and, in places, rather challenging flare-lit path from the mountain train to the restaurant. On arrival, they had the opportunity to mingle in a convivial atmosphere and enter draws to win a Tissot T-Touch watch and other gifts, which has been a highlight of the event over the years.

Programme

Participants were welcomed on the opening day by representatives from the organisers, namely Prof. Dr. Volker Saile, chief science officer of KIT (the Karlsruhe Institute of Technology) and president of MANCEF, Danick Bionda, secretary general of Micronarc, and David Kappeler, project manager, Office for Economic Affairs, canton of Vaud, Switzerland.

This year, 19 invited talks, seven of which were given by keynote speakers, were selected on the basis of topics relevant to manufacturers of microproducts and sensor systems. Brief outlines of the talks presented by the speakers are given below. Particular features of the programme were the state-of-the-art reviews of various manufacturing technologies and the manufacture of new products.

The tabletop exhibition, located next to the meeting room, was where the breaks were held, enabling everybody to mix and network. It featured insights into new equipment and manufacturing processes. After each session, exhibitors were given a three-minute time slot to make their pitches.

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▶ *Participants making their way on foot from the mountain train to the Golf Villars restaurant, situated at an altitude of 1,600 m.* ▶

▶ *The traditional mAm evening dinner at Golf Villars restaurant.* ▶

Future of micro-manufacturing 1

Keynote: Prof. Philippe Renaud, Microsystems Laboratory 4, EPFL (École Polytechnique Fédérale de Lausanne), Switzerland.

Talk: From the lab to the fab: how simple technologies translate into innovative products.

This talk traced the steps along the risky path from a development in the laboratory to a marketable end-product. Success depends on having a realistic knowledge of materials, processes, regulatory issues and production costs. It was stated that researchers in academia needed to be aware of production costs and explore how they can be reduced.

A number of case studies were cited with particular reference to biomedical products, showing how production costs can be minimised by using low-cost techniques such as plastic injection moulding for cartridge manufacture for biomedical products. The US$5 bn market for cardiac stents was quoted as an example where low-cost production yielded a 1,000% trade margin.

Micro-manufacturing applications 1—watchmaking

Keynote: Thomas Mercier, R&D scientist and project manager, Tag Heuer, Switzerland

Talk: Compliant watch mechanisms—design and manufacturing challenges at mesoscale

A detailed technical presentation was given relating to the challenges of manufacturing mesoscale (1–10 mm) watch parts, where the smallest feature sizes were in the range of 10–100 µm. A range of techniques used for manufacturing the parts were described, which included deep reactive-ion etching (DRIE), laser cutting, lithography, electroplating and moulding (LIGA), wire electrical discharge machining (EDM) and milling.

Micro-manufacturing applications 11—medtech

Keynote: Prof. Dr. Ute Schepers, group leader, Institute of Toxicology and Genetics and Institute of Applied Biosciences, KIT, Germany.

Talk: Bioprinted organs-on-a-chip

This fascinating talk was accompanied by slides of miniaturised organs growing on chips. Researchers at Prof. Schepers's institute have developed organ-on-a-chip systems based on cells from healthy humans. Miniaturised organs are applied onto a chip using 3D printing methods. The research team developed such a system with a physiologically correct model of blood vessels using round, porous channels. This was done to test drugs more safely and reduce animal testing prior to their being administered to humans.

Prof. Schepers's team developed the vasQchip in cooperation with scientists of other disciplines at vasQlab, a KIT spinoff company. It was developed as an in vitro model for vascularised 3D tissue. On the vasQchip, the substances to be tested enter the miniaturised organs via artificial blood vessels. The organs' reaction can then be evaluated automatically. Miniaturisation enables parallelisation and automation of thousands of tests on the smallest space. Presently, the team is working on the development of perfused skin, liver, intestinal organ and tumour models as well as the combination of various miniaturised organs on a chip.

▶ *Winner of the Tissot-Touch watch, Dr. Bastian E. Rapp, NeptunLab, Institute of Microstructure Technology (IMT), KIT.* ▶

MEMS are now growth enablers of the semiconductor market. Emphasis is being placed on more accurate, reliable smart sensors and systems for the next automation age, covering smart manufacturing and autonomous driving applications.

Sensors

Keynote: Benedetto Vigna, executive vice president and general manager of Analog, MEMS & Sensors Group, ST Microelectronics, Italy/Switzerland.

Talk: Carrying the MEMS torch in a new era

Benedetto Vigna gave an excellent updated review with many visual examples of successful MEMS products and their markets over the last twenty years. The trends are now towards smart sensors and actuators for a whole range of consumer products, including wearable, environmental and home monitors for energy monitoring, etc. These are advancing the IoT revolution.

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Future of micro-manufacturing II

Keynote: Prof. Dr. Harald Giessen, director, 4th Physics Institute, University of Stuttgart, Germany.

Talk: Complex micro-optics by femtosecond 3D printing

3D printing has revolutionised the manufacturing of complex shapes. The group at Stuttgart have applied this to making precision optical components. This interesting talk described a detailed process for making miniaturised, almost aberration-free optical surfaces using a femtosecond laser (with a pulse duration of 100 femtosecs) and a liquid photoresist. This method allows for the creation of optical freeform surfaces with sub-micron accuracy. Furthermore, 3D printing on single-mode fibres has been made possible.

A number of examples were given of applications where such optical components can deliver improved accuracy. These include the construction of novel and extremely small lenses for endoscopes that are suited for smallest body openings or inspecting machine parts.

Printing optical freeform surfaces and miniature objectives directly onto complementary metal-oxide semiconductor (CMOS) image chips can be used to create extremely compact sensors. Using such optics, miniaturised cameras as small as bees could be made for a variety of applications, for example, cameras in drones and robots for autonomous vehicles and surround cameras in cell phones.

Energy systems for microproducts

Keynote: Bastian E. Rapp, NeptunLab, Institute of Microstructure Technology (IMT), KIT, Germany

Talk: Next generation 3D printing: the emergence of enabling materials

This detailed technical talk concentrated on the properties of materials suitable for rapid prototyping (RP) of MEMS and microfluidic devices, including liquid polystyrene and liquid polymethymethacrylate (PMMA) for 3D printed thermoplastics.

It described the various processes used for 3D printing, including the development of liquid glass microstructures. The process, True3DGlass, was the first technology for free-form 3D structuring of glass by 3D printing. This revolution in glass processing could be a disruptive technology for many applications and industries.

Dr. Benjamin Strahn, R&D manager, Meyer Burger Research, Switzerland.

Talk: Energy harvesting from the sun—a technology status and outlook

Meyer Burger Swiss is a global technology group specialising in innovative systems and processes based on semiconductor technologies. The company's structure and work in advanced technologies and precision products, which are based on semiconductor technologies, with a focus on photovoltaics (PVs), was given.

The latest developments in PV technologies and the current status of the global markets were illustrated. Comparisons of the efficiencies and costs between multijunction cells, crystalline silicon cells, thin film technologies and emerging PVs were shown together with future market trends up to 2050 for the various materials and processes.

David Tolfree is vice president of the Micro-Nano and Emerging Technologies, Commercialisation, Educational Foundation (MANCEF). He is a professional physicist with over forty years' research and managerial experience, having worked for the UK Atomic Energy Authority (UKAEA) and Research Councils UK (RCUK). He was the co-founder and director of Technopreneur, a technical consultancy company for the commercial exploitation of micro-nanotechnologies and a consultant to UK government departments on micro-nanotechnologies. He is one of the founding members of MANCEF and the UK Institute of Nanotechnology and is a member of the UK's Knowledge Transfer Network (KTN). David has 173 publications, including roadmaps, newspaper, magazine and journal articles and books. He has been an organiser, chair and speaker at many international conferences and given interviews on television and radio on micro-nanotechnologies. He is an editor and reviewer for a number of related scientific journals.

Future of micro-manufacturing III

Keynote: Dr. André Kretschmann, Robert Bosch, Germany.

Talk: Sensors in the changing times

This informative talk from a leading world manufacturer of MEMS sensors was composed of four topics covering the staff composition, research activities since 2013 and global location of Bosch's extensive research and advanced engineering work. The basis of the work at Bosch on MEMS and the historical development of MEMS production since 1995, with 8 bn sensors and more than 1,000 patents, was described.

The company is a world leader in MEMS design and production, with a revenue approaching US$1.2 bn. The three waves of MEMS proliferation and the future of MEMS, covering automotive applications, consumer electronics and the IoT, was particularly interesting. Since the production of the first acceleration sensors in 2005, devices are now available for a whole range of applications, from digital pressure sensors to domestic and environmental air sampling.

The third wave for MEMS sensors covers a multitude of markets and is the enabler for the IoT, particularly in terms of autonomous transport, environmental monitoring, health and security. Interconnected smart sensor systems and integrated sensor hubs will be key drivers in Industry 4.0.

Prof. Dr. Volker Saile gave a summary of the talks and Danick Bionda delivered the final remarks and closed the conference.

Many talks this year were related to the further development of those processes and techniques that will advance future manufacturing for microproducts, particularly with reference to the onset of Industry 4.0. ●

The mAm2018 conference will be held at the same venue on February 10–12, 2019.

mAm 2018
http://mam2018.ch