

DEAR FRIENDS, DEAR COLLEAGUES,

It's hard to believe that 2023 is soon ending and that this is our last newsletter issue before the special in December. We are now all in preparation for the IMEKO World Congress in Hamburg, Germany, 2024's great event. But before we get there, there is much to tell about the recent IMEKO events. This issue brings the success of the joint TC8 Traceability in Metrology, TC11 Measurement in Testing, Inspection and Certification and TC24 Chemical Measurements conference held with EUROLAB in Madeira, Portugal. As part of this event, yet another scope is the introduction of the Sensor Group with young scientists from Prague, the Czech Republic, who also participated in this event. This time's introduction is very special; it's about Mr Torben Rask Licht, who is a long-time Hottinger Brüel & Kjær (HBK) affiliated who was also among the founders of the IMEKO TC22, Vibration Measurement. Our online journal Acta IMEKO presents this year's third issue with various articles. Last but not least, the Presidential Board continues with their frequent meetings. The highlights of their last one are brought to you here.

NEWS FROM THE PRESIDENTIAL BOARD

The Presidential Board continues after the recent General Council Sessions with frequent meetings; the last occurred in October. The participants are Prof. Frank Härtig, Prof. Masatoshi Ishikawa, Prof. Paolo Carbone, Prof. Kenneth Grattan, Prof. Elisabeth Costa Montero (invitee to the meeting) and Mr Zoltan Zelenka. From the highlights:

IMEKO recently received several invitations from our external partners, a sign of more successful collaboration, which is undoubtedly on the way. The IMEKO EUROLAB joint conference took place in Madeira-Portugal. The Inter-American Metrology System (SIM) organises a SIM week in November, and IMEKO shall participate in the open day. The Confederation is invited to the Asia Pacific

Metrology Programme (APMP) General Assembly in December. Some activities are already foreseen with GULFMET shortly after the recently signed partnership.

At our next General Council Sessions, the triennial elections will take place. For more details, please contact the Secretariat.

A short Technical Board meeting will be organised for the second half of January. The topics of the meeting are the continuation of the Working Groups, such as Publishing, Technical Committee Functioning, part of it the TC interest Survey, the Technical Board Functioning, the Technical Committee Events, the new Working Groups on IMEKO Branding, and the other on Digitalisation.

These groups still welcome new volunteers!

Host Member Organisation:
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imeko2024



**IMEKO 2024
 XXIV World Congress**

26–29 August 2024 | Hamburg, Germany

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A LIFE FOR THE CHARACTERISATION OF VIBRATION



When Torben Rask Licht was born at the end of World War II in Copenhagen's northern suburb Naerum, it was near where a small company founded at the beginning of the

war was moving in 1948. That company would, right away, achieve great fame. The two founders were Per V. Brüel, an engineer and businessman and Viggo Kjær, an engineer and scientist. The name of their company, "Brüel & Kjaer", was soon to be known even by ordinary people in the streets of Copenhagen's downtown, as their technology proved internationally superior.

With great admiration, Torben saw the company ground of Brüel and Kjaer growing rapidly. At the time he began his studies at Denmark's No. 1 technical educational institution, DTH, today DTU, in 1962, he chose, not entirely by chance, solid-state physics and electronic engineering. He got employed at B&K within a week after a phone call, 3 weeks after his graduation in February 1968.



In the first part of the seventies, Torben was part of the team creating the new and remarkably successful range of DeltaShear™ accelerometers.

He holds a patent on the construction (see the picture of a cut-open accelerometer).

Transducer calibration is important. The method used in 1968 was a microscope

measuring the peak-to-peak displacement at the well-stabilised 50 Hz mains supply. In 1970, he presented a practical interferometer system for the absolute calibration of reference standard accelerometers. The system came into regular use in 1971. In 1991, B&K established the Danish Primary Laboratory of Acoustics (DPLA) as the National Metrology Institute for calibrating accelerometers and microphones. Torben ran the vibration part from then up to his retirement in 2018.

Rapid sampling digital techniques made new ways of treating the interferometer outputs. This is reflected in the ISO 16063-11 1999 standard.

FFT analysis and analysers became a part of the B&K DNA in the 1980'ties. It had a large impact on the way to calibrate transducers. In late 1988, B&K won a huge calibration system order by some Aerospace customers. It was a PC-controlled calibration system using an FFT analyser. Over the next half year, Torben and a small group worked around the clock to reach the goal and succeeded with the system Type 9610. This became the origin of later vibration calibration systems, today the Type 3629.

In 2003, Torben had discussions during ISO TC108 meetings (which he was chairing) with Dr. Thomas Bruns from PTB about a venue for exchanging vibration calibration techniques, as it was not present in current conferences. Thomas suggested trying to make a group in IMEKO, and Torben agreed. The first meeting of TC22 was held in 2006 in Rio, where Torben presented a paper describing the equivalence of the FFT method to the so-called sine approximation described in the 1999 standard. He also presented validating measurements from a newly developed system based on a B&K PULSE analyser.

Multiple FFT channels also created a need for easy identification. B&K came up with a solution later endorsed by the IEEE1451.4 Working Group. In 1998/99, the draft standard was ready, and production of transducers started. Torben joined the group and became the chair of the IEEE1451.4 WG in 2001. The TEDS (Transducer Electronic Data Sheet) standard was finalised in 2004, and Torben is still chairing the group. He is also still working for HBK as a consultant, mainly for calibration and accelerometer R&D.

Vibrations brought Torben in contact with many interesting and challenging projects from the deep sea (submarine accelerometers) to deep space (Comet lander leg vibration) and travelling around the globe about 20 or more times.



Hottinger Brüel & Kjær (HBK) originates from Brüel & Kjær Sound & Vibration (BKSV) and Hottinger Baldwin Messtechnik (HBM). Brüel & Kjær A/S was founded in 1942 to become the world's leading supplier of advanced technology for measuring sound and vibration. HBM GmbH was founded in 1950 to soon be a master in precision measuring techniques based on the strain gauge principle such as torque, force & strain (Contact: A. Sc.)

ASIA PACIFIC MEASUREMENT FORUM ON MECHANICAL QUANTITIES 2023



APMF2023 will be held online on 20-24 November 2023.

It will be the 15th Asia Pacific Measurement Forum on Mechanical Quantities, following a long tradition of technical events initiated in 1992. APMF 2023 will be organised by the National Institute of Metrology, China (NIM) and the Chinese Society for Measurement (CSM) and co-sponsored by the International Measurement Confederation (IMEKO).

Measurement technology on mechanical quantities constitutes an integral part of the

intellectual infrastructure for a wide range of human activities, from quality assurance for machinery, architecture, aerospace, and shipbuilding industries to fair trade. The Asia Pacific Forum on Mechanical Quantities (APMF) has been offering participants the opportunity to exchange the latest information on R&D in these fields and extend friendships. It has been growing steadily as a not-to-miss event for technical experts from industry, national metrological institutes, calibration/testing laboratories and other stakeholders, especially those actively working in the Asia-Pacific region.

The name of "Asia Pacific Measurement Forum on Mechanical Quantities (APMF)" has been considered and changed from "Asia Pacific Symposium on Measurement of Mass Force and Torque (APMF)" in 2017. In addition, the scope of APMF activities has been extended into further mechanical quantities such as hardness, pressure and vacuum.

[Asia Pacific Measurement Forum](#)

THE HISTORY OF TC4, MEASUREMENT OF ELECTRICAL QUANTITIES, FOURTH PART

The continuation of the article in the Newsletter April 2023 by Mario Savino



In the picture from left to right: Jan Holub, Vladimir Haasz, Alan Belcher, Mario Savino, Pasquale Daponte, Milos Sedlacek, Jan Holub

"13. The development of Data Acquisition Systems

The 7th Workshop on "ADC Modelling and Testing" was held in Prague, Czech Republic, June 26-28, 2002. Vladimir Haasz was able to organise the joint 7th Workshop on ADC Modelling and Testing and the 4th ADDA Conference despite the difficulty of cooperation with IEE. However, it was necessary for the whole IMEKO. Due to the increasing importance of data acquisition systems (DAS), which interface between the worlds of analogue physical and chemical parameters and digital computation and control, the TC4 decided to organise a Summer School on this topic. L. Michaeli reported the positive results from the 2nd Summer School on DAS during the meeting. Particular emphasis was placed on the possibility of setting up new measurement instruments using digital circuits, which were low-cost, accurate, and relatively simple to implement. The process of data acquisition (DAQ) for measuring an electrical or physical phenomenon uses analogue-to-digital (A/D) and digital-to-analogue (D/A) converters in combination with sensors inside a modular hardware. It also requires flexible software to obtain measurement or

control systems for several specific applications in information and communication technologies (ICT), electro-mechanical industries, civil engineering, and smart devices for homes and future cities. The 12th International Symposium on "Electrical Measurements and Instrumentation" was held in Zagreb, Croatia, September 25-27, 2002 and was organised by Mladen Borsic. During the TC4 meeting, the members declared Milos Sedlacek as the new Chairman, Antonio Serra as the new Deputy Chairman, and Pasquale Daponte as the new Scientific Secretary of the IMEKO TC4. The new Chairman, Deputy Chairman, and Scientific Secretary thanked the TC4 Board for its confidence and invited the TC4 members to appoint me as Honorary Chairman.



In the, middle Mladen Borsic, Mario Savino,

14. Conclusion

I close this paper with the new scope of TC4: "The objectives of TC4 are to deal with Electrical Measurements in the broad sense, i. e., including both power and high-frequency measurements, which are vital in various fields of science and technology. Progress in the domain of electrical measurement science and instrumentation is swift: it continually offers new possibilities in accuracy and speed of measurement". As you can see, the high frequency is an integral part of TC4 scope, so Adam can rest in peace.

History is the teacher of life; whenever I resort to memory, one of the most important resources of humanity, then my daily work becomes more peaceful and less tiring. I think that if I did something in the past, I would be able to do it even better today or tomorrow. The beauty of memories is that they are placed in our minds out of time. We must make an effort, probably unnecessary, to define their date. The extraordinary thing is that the remembrances are relived as many times as we want, when and whenever we feel the need."



Written by Mario Savino

THE JOINT TC8 TC11 AND TC24 CONFERENCE IN MADEIRA, PORTUGAL WITH EUROLAB



The Joint Conference of the IMEKO Technical Committees TC8 Traceability in Metrology, TC11 Measurement in Testing, Inspection and Certification and TC24 Chemical Measurements conference was held in Madeira, Portugal at the Congress Center of the Hotel Vidamar, in Funchal (R. A. da Madeira), with the organisation of RELACRE and the support from LNEC, ARM (Water and Resides of Madeira), the University of Madeira and the Madeira City Council. At this event, the National Members Meeting of EUROLAB aisbl also occurred.

The opening ceremony was attended by His Exc. the Regional Secretary for Equipment and Infrastructure, Eng. João Pedro Castro Fino, and His Excellency the City Mayor of Funchal, Dr. Pedro Miguel Calado. From the organisation, the highlights are the welcome speeches by Álvaro Silva Ribeiro, President of RELACRE Association of Accredited



In the picture from left to right, Tatjana Tomic, Paolo Moscatti, João Pedro Castro Fino, Alvaro Silva Ribeiro, Pedro Miguel Calado and Thomas Wiedenhofer.

Laboratories of Portugal and Chairperson of IMEKO TC 11, Paolo Moscatti, President of the Board of EUROLAB, Tatjana Tomic, Chairperson of IMEKO TC24, and Thomas Wiedenhofer Scientific Secretary of IMEKO TC8.

The scientific program had the participation of several international guest speakers, namely Damiano Pietri, President of Metricode, with an intervention entitled "Digitisation of Laboratory Processes: the ABC Balance-Metricode case", Laura Martin, Secretary General of EUROLAB, who spoke on the topic "EUROLAB: an International Collaboration Towards the Lab of the Future", Sascha Eichstädt, Director of the PTB from the Department "Metrology for

Digital Transformation", with the topic "Digitalisation of the Quality Infrastructure", Přemysl Fitl, the University of Chemistry and Prague Technology, addressing the topic "Solid-State Gas Sensors and their Applications in the Field of Metrology" and a guest intervention by James Connelly, CEO of My Green Lab based in the USA.



In the pictures are Damiano Pietri, President of Metricode and the Secretary General of EUROLAB, Laura Martin.

This event brought together, for the first time, several communities from the ICT (Testing, Inspection and Certification) sector of the IMEKO Technical Committees with delegates from the European Associations of Laboratories that are members of EUROLAB aisbl, Academia, Industry and Laboratories, bringing together around 70 participants from 22 countries (Germany, Brazil, Saudi Arabia, Croatia, Philippines, Italy, North Makedonia, Portugal, Czech Republic, England, Ukraine, Austria, Switzerland, Poland, Belgium, Romania, Denmark, Netherlands, Greece, Spain, France, United States). The event allowed the sharing of knowledge and ideas, resuming face-to-face contact and strengthening the Science and Technology networks that support the activities carried out in this sector.



Parallel Session in the Vidamar Conference Center



Welcome reception in the City Hall hosted by the City Mayor of Funchal.



Cultural visit to a Madera Vinery



Conference dinner in a typical Madeira restaurant



Group photo of the Joint IMEKO Conference & EUROLAB National Members Meeting.

TC24 CHEMICAL MEASUREMENTS - INTRODUCING THE SENSOR GROUP FROM THE UNIVERSITY OF CHEMISTRY AND TECHNOLOGY FROM PRAGUE



On the picture from left to right: Jan Kejzlar MSc. (doctoral student, temporary member); Jaroslav Otta MSc. (doctoral student, temporary member); Michal Novotný, PhD (permanent member); Martin Hruška MSc. (doctoral student, temporary member); Přemysl Fitl, PhD (permanent member); Joris More-Chevalier, PhD (temporary member); Prof. Martin Vršata (permanent member); Šárka Havlová, PhD (former doctoral student, temporary member)

The Sensor Group at the University of Chemistry and Technology in Prague (Department of Physics and Measurement) is a research team focusing on both basic and applied research of chemical gas sensors (chemiresistors, QCM resonators and luminescence sensors). We dedicate ourselves to the theoretical consideration of composition and morphology, subsequent deposition of the tailored thin-film structures, characterisation of their electrotransport and optical properties and, finally, characterisation of their surface physico-chemistry during interaction with gaseous species. In cooperation with our industrial partners (Tesla Blatná, a.s., Draslovka Lučební závody Kolín, a.s.), we transfer the experience mentioned above and technology from the laboratory scale to industrial production capacities, thus participating in the production of small modular chemical gas sensors as well as more sophisticated detector devices.

Our portfolio of investigated materials includes highly nanostructured and nanoporous materials, black metals (BMs) or oxidic aerogels, inorganic semiconductors (SnO_2 , ZnO), organic semiconductors (phthalocyanines, polypyrrole), polymer ionic liquids, and an array of composites and nanocomposites. These materials serve as the canvas for our sensor technologies, each with unique properties and applications.

At our disposal, we have a spectrum of advanced preparation techniques, including Physical Vapor Deposition (PVD) - Pulsed Laser Deposition (PLD), Vacuum Thermal Evaporation, Magnetron Sputtering, or Continuous Wave Laser-Induced Forward Transfer (CW-LIFT).

Our journey doesn't stop at material preparation. We embark on a deep exploration into sensor-gas interactions, investigating electrical parameters of the sensitive layer such as resistivity and impedance for chemiresistors applications, surface physi-or chemi-sorption for QCM sensors, or reflectivity and luminescence for optical gas sensors. Moreover, our studies encompass interference phenomena and detection mechanisms, laying the foundation for a deeper understanding of sensor operation. To enable such level of material studies/characterisation, the laboratory has the following equipment for measurement sensor parameters: In-house developed systems for measurement of sensor sensitivity dependence on temperature; In-house developed system for sensor long-term stability measurement; Pfeiffer Vacuum Omnistar GSD 320-gas analyser with quadrupole mass spectrometer (0-300 amu); Gas Dortmund-GC-IMS-gas chromatograph with ion mobility detector; Gas mixer with permeation tube vapour generator Sonimix; Cells for testing of sensors with connection to a gas distribution system, electromagnetically shielded, with terminals.

for measuring the resistance /impedance of the sensitive layers and with a four-wire connection of the heating meanders; Gas distribution systems; device for mixing of gas mixtures based on mass flow controllers,

Equipment for measurement of electrophysical parameters:

Quantum Design PPMS (Physical Property Measurement System) with modules for measurement of electro-transport properties in temperature range 2-400 K and magnetic fields up to 9 T; Electrometer Keithley 6517A-precise measurement of high resistance materials with in-house fixtures with triaxial interconnection; Delta mode system Keithley 6221/2182-low noise resistivity measurement; Impedance analysers Agilent 4294A, Keysight E4990A, Gamry Reference 600; Turbo pumped vacuum LN cryostat for impedance measurements

Our effort aims at sensors meticulously customised to cater to a wide area of applications. These applications include:

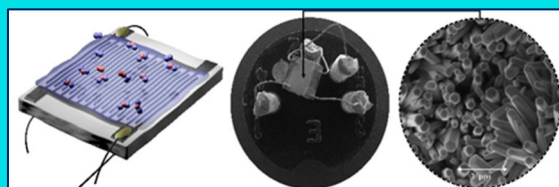


Fig. 1: 3D Scheme and SEM Image of Chemiresistor with Semiconductive ZnO Active Layer

1. Security Systems for Early Detection:

The development of sensors for the early identification of chemical warfare agents and taggants of explosives. In the contemporary world, the importance of security cannot be overstated.

(Maresova, E. et al., Sensors and Actuators B: Chemical, 266 830-840.)

2. Industrial Systems for Gas Detection and Leakage:

Managing hazardous gases like NO₂, NH₃, CO, VOCs, and H₂ is crucial in the industrial sector. Our sensors provide reliable detection solutions, ensuring safety and efficiency.

(Hruska, M. et al., Applied Surface Science, 158618.)

3. Monitoring Systems for Environmental Pollution:

As the concerns surrounding environmental pollution escalate, we actively contribute to developing systems that enable monitoring and mitigating environmental threats.

(Tomecek, D. et al., ACS Sensors, 3(12), 2558-2565.)

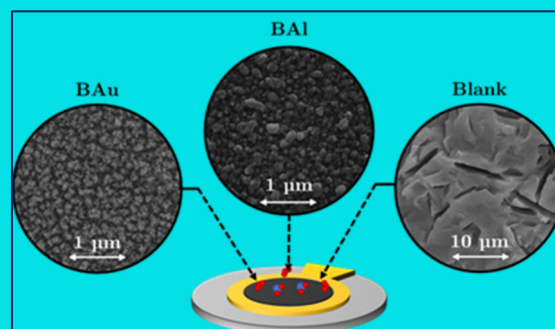


Fig. 1: Quartz Crystal Microbalance (QCM) Sensor with Nanostructured Black Metal Layer

An integral part of our work is participation in research projects. Notable among them are projects funded by NATO, the Visegrad Fund, the Ministry of Education, Youth, and Sports of the Czech Republic, the Ministry of the Interior of the Czech Republic, and The Czech Science Foundation (GACR).

However, we also foster international collaborations with institutions such as IM2NP and the University of Tartu in Estonia.

Education is another important aspect of our activities. We ensure the transfer of knowledge and expertise in fields like sensor devices, chemical sensors, measurement, control systems, and metrology.

We prepare the next generation of experts to sustain the momentum of innovation. Assoc. prof. Karel Kadlec, a member of our group, is the author of a comprehensive monography dedicated to measurement in the industry.

(Karel Kadlec et al. *Measurement and Control of Chemical, Food and Biotechnological Processes Volume I Process Measurement*, Key Publishing (Ostrava, Czech Republic) 2019, ISBN: 978-80-7418-306-5.)).

In the spirit of global collaboration and the pursuit of innovative solutions, we are currently engaged in a ground-breaking venture. The Visegrad V4-Japan project unites our expertise with international partners to advance highly nanostructured materials for sensor applications.

Our collaboration with Tesla Blatna, *a.s.*, a distinguished Czech company specialising in automotive and electronic components, has been instrumental. They are renowned for producing gas sensors, temperature sensors and gas-sensing substrates. We have successfully expanded their product line to include a diverse range of sensors for both industrial and automotive applications.

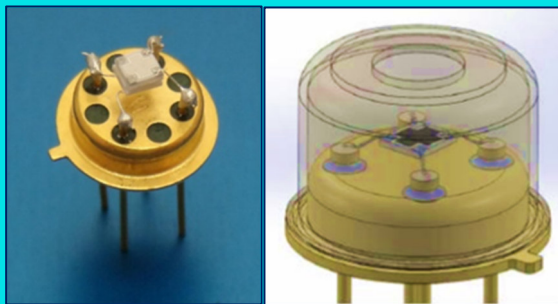


Fig. 3: Patented chemiresistor substrates KBS4 available on the market developed by our team with the cooperation of Tesla Blatna a.s.

We invite you to join us in our relentless pursuit to find new paths in sensor technology, forge cost-effective solutions, and address the pressing challenges spanning many industries.

We have become members of the Czech National IMEKO Committee and IMEKO International Measurement Confederation TC24 Chemical Measurements in 2014.

Our involvement with IMEKO has led to many new opportunities to connect our group with a metrological society involved in chemical sensor development and testing and the analysis and preparation of gaseous mixtures. The result is then the absorption of metrological know-how, the enrichment of the teaching process and a greater interconnection of our basic and applied research with practice.

In TC24 Chair Tatjana Tomić, Scientific Secretary Prof. Leonardo Iannucci and all of us work together to connect scientists in the different fields of chemical metrology by organising meetings and conferences and improving cooperation with other IMEKO TCs and other organisations.

We would like to thank Prof. Vladimír Haasz from the Czech Technical University in Prague and Prof. Jaromír Volf from the Czech University of Life Sciences in Prague for their efforts in organising the activities of the Czech IMEKO and support of the young generation dealing with Metrology, Sensors and Measurement and control topics.

Please do not hesitate to contact us if you wish to learn more about our work or explore collaborative opportunities.



Head of the Group: Prof. Dr Martin Vršata
(vrnatam@vscht.cz)

Vice Head: Přemysl Fitl, PhD (IMEKO TC24 contact person for the Czech Republic)
(fitlp@vscht.cz)

TIC TALKS WITH TC11 ONLINE WORKSHOP



The next in the "TIC Talks" series with TC11 Measurement in Testing, Inspection, and Certification is "Traceability in Certification Scheme for Reliable Results" on 21 November 2023 at 13:00 CET.

Traceability ensures each step of the chain (scheme) is performed in accordance with appropriate methods.

Metrological traceability is established by considering and ensuring the measurement uncertainty for each step of the scheme (chain) is evaluated according to the appropriate method.

Traceability ensures comparability of measurement results both nationally and internationally.

Mrs Gertrude Mamiya, Consumer product microbiology officer /National Quality Testing Division /Rwanda Standards Board, shall moderate the event.

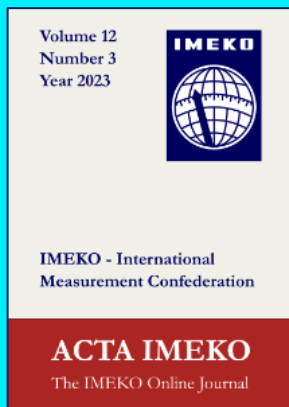
Link: (the link is active only during the meeting)

<https://us06web.zoom.us/j/85475910765?pwd=r4BpL4cv9D1ycQrLymr7ncsRfyDeKv>

Meeting ID: 854 7591 0765

If you wish to find out more, please visit [TC11 Homepage](#)

THE THIRD ISSUE OF ACTA IMEKO 2023



The third issue of our open-access online journal, Acta IMEKO is complete. The publication of the first articles started early in August, and we now have 40 scientific papers from quite different fields, but all related to measurement.

Besides the introduction to the General Track, there are four editorials introducing the "Thematic issues":

Measurement Systems and Instruments based on IoT Technologies for Health

Selected papers from the 2022 IMEKO TC11&TC24 Joint Conference (2nd part on testing, inspection and certification as well as chemical measurements)

Selected papers from the 2022 IMEKO TC4 symposium on electrical measurements

Selected papers from the 2022 IMEKO International Conference on 'Metrology for Archaeology and Cultural Heritage'.

As always, feel free to read all [Acta IMEKO](#) articles on the journal's website.

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