University of Stuttgart
Institute for Large Area Microelectronics

Annual Report

2021

IGM
Institut für Grossflächige Mikroelektronik

Publisher

Universität Stuttgart / University of Stuttgart
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March 2022

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1 Preface

Dear friends of the Institute for Large Area Microelectronics,

We are pleased to present our activities and news of the year 2021 to our scientific cooperation partners, alumni and all our other friends.

Despite ongoing restrictions due to the COVID-19 pandemic the institute was able to offer the usual courses in 2021. While teaching was still held completely virtually in the summer semester 2021, a normal face-to-face teaching was possible again in the winter semester 2021/22 to the great relief of the students and lecturers.

Although as an exception, the lab course "Fundamentals of Electrical Engineering" could only be offered virtually to the student class 2019/20 in the summer semester 2021, the student class 2020/21 benefited again from the experience of an in person lab course in the winter semester 2021/22. As the clean room area with dedicated clean room clothing, face mask, gloves and air circulation with particle filter ensures compliance with all hygiene regulations, both the regular "Flat Panel Displays" lab course at the end of the summer semester as well as the student theses and the research theses could proceed almost normally thanks to the extremely disciplined and committed efforts of all employees and students.

However, the Eurodisplay, which had already been postponed to the end of September 2021, had to be postponed again by one year as an easing of the corona restrictions only became visible in the fall. The special benefit of the Eurodisplay is the direct personal exchange between the participants so that a shift is preferred over a purely online conference.

The current research activities are focused on the further development of integrated processes for the production of micromechanical electrical systems and thin film transistors, the realization of active matrix micro-LED and high-resolution actively driven LC modulators for 3-D applications as well as the development of quantum-based gas sensors within the Research Training Group "Photonic Quantum Engineers" (GRK2642).

In February 2021, the worldwide first XTPL® DELTA Ultra-Precise Deposition (UPD) Printing System had been put into operation at the institute. This system enables the precise deposition of high-viscosity inks, so that for

example conductive structures with lateral dimensions in a low single-digit micrometer range can be realized in a purely additive way. At the same time as the UPD printer was implemented, several project proposals were prepared and submitted with the aim to demonstrate high-resolution additive structures in applications such as novel assembly technologies for high frequency circuits or micro LED displays. Just before the end of the year, the institute was informed that the project for the investigation of an additive assembly technology for a 140 GHz radar will be approved and can start in spring 2022.

In February 2021, we were also informed that LG Display Co. finally decided, after a fairly long lawsuit, to acquire a license for a 3 TFT active matrix OLED pixel circuit invented by the IGM which is used in almost all OLED televisions sold worldwide. Due to the high litigation risk, the institute had sold the respective patents to a licensing agent, but profits from the licensing proceeds on a percentage basis.

I would like to thank all friends of the institute for their support and inspiration and wish you all ongoing good health.

A special thank you to all employees for their tireless commitment ensuring the successful work of the institute on a daily basis. I also sincerely wish you and your families health, happiness and all the best.

Stuttgart, March 2022

Prof. Dr.-Ing. Norbert Fruehauf

2 The Institute

The Institute for Large Area Microelectronics (IGM) is a research and education institute with a major focus on application-oriented research and development of new processes and materials for applications in display technologies.

With its more than 500m² of clean room area the Institute of Large Area Microelectronics operates one of the leading independent laboratories for the research and development of thin film electronics and thin film technology (TFTs) as well as their respective fields of application, e.g.:

- Flat panel displays (LCD, OLED)
- Smart Glass
- Optical signal processing
- Micro-electro-mechanical systems (MEMS)

The laboratory has always been focused on application-oriented research and portability to industrial grade production. Therefore, the clean room lab was designed to build complete active matrix LCDs on glass substrates of up to 16 inches squared. This capability to process such (relatively, for a research facility) large substrates gives the laboratory at the Institute for Large Area Microelectronics a unique position in all of Europe.

Besides the extensive research activities of the institute, the university teaching plays an important role. In teaching the institute represents the fundamentals of electrical engineering as well as display and thin film technologies.

3 Staff Members

Function	Name	E-mail @igm.uni-stuttgart.de	Phone +49 711 685-
Head of Institute	Prof. Dr.-Ing. Norbert **Fruehauf**	norbert.fruehauf	66922
Vice Head of Institute/ Head of Laboratory	Dipl.-Ing. Lothar **Rau**	lothar.rau	66927
Vice Head of Laboratory	Dipl.-Ing. Holger **Baur**	holger.baur	66926
Secretary	Birgit **Schuder**	birgit.schuder	66922
Facility Management	Joerg **Bachofer**	joerg.bachofer	66933
Scientific Staff	Florian **Kleber**, M.Sc.	florian.kleber	69321
	Sheikh Abdullah Al **Nusayer**, M.Sc.	sheikh.nusayer	66931
	Dipl.-Ing. Christiane **Reinert-Weiss**	christiane.reinert-weiss	66930
	Dr.-Ing. Patrick **Schalberger**	patrick.schalberger	69320
	Yannick **Schellander**, M.Sc	yannick.schellander	66929
	Annika **Schmekal**, M.Sc.	annika.schmekal	66925
	Dipl.-Phys. Marc **Wilke**	marc.wilke	66904
Technical Staff	Daniela **Schalberger**, B.Sc. CTA	daniela.schalberger	69305
	Elisabeth **Schuler**	elisabeth.schuler	66908
Lecturer	Dr. Hagen **Klauk** Max-Planck-Institut	hagen.klauk@ fkf.mpg.de	0711/689-1401

4 Teaching

Professor Fruehauf offers lectures on fundamentals of electrical engineering, filter synthesis, optical signal processing, thin film technology and flat panel technology. Several lab courses allow the students to gain some hands-on experience complementing the lectures.

4.1 Lectures

All lectures are recorded and uploaded on ILIAS to give the best possible support to the students.

Fundamentals of Electrical Engineering 1

Lecturer: Prof. Dr.-Ing. Norbert Fruehauf

Winter semester, 1 semester, 1st semester Bachelor's program Electrical Engineering & Information Technology, Mechatronics and Renewable Energies

- Introduction and overview
- Voltage and electric current
- Ohm's Law
- Electric power
- Kirchhoff's Laws
- Network analysis
- Electric field
- Capacities
- Magnetic field
- Induction Law

Fundamentals of Electrical Engineering 2

Lecturer: Prof. Dr.-Ing. Norbert Fruehauf

Summer semester, 1 semester, 2nd semester Bachelor's program Electrical Engineering & Information Technology, Mechatronics and Renewable Energies

- Inductances
- Sinusoidally alternating quantities
- Circuits at alternating currents
- General two-poles
- Modulated sources
- Resonant circuits

The two-semester module "Fundamentals of Electrical Engineering" consists of:

- Weekly lecturers
- Bi-weekly lecture exercises
- Bi-weekly group exercises (Electrical Engineering & Information Technology B.Sc. and Renewable Energies B.Sc.: winter semester compulsory, Mechatronics B.Sc.: winter **and** summer semester compulsory)
- Lab course "Fundamentals of Electrical Engineering" (compulsory)

Important notice:
The module examination "Fundamentals of Electrical Engineering" is a mid-degree exam of Electrical Engineering and Information Technology B.Sc. The right for examination expires if the mid-degree exam is not passed until beginning of the 4th semester (inclusive a written retry).

Filter Synthesis

Lecturer: Prof. Dr.-Ing. Norbert Fruehauf

Winter semester, 1 semester, Master's program

- Introduction
- Mathematics foundations
- RLC-Two-Poles
- Realization of filters
- Transformation of RLC-circuits into active RC-circuits
- Synthesis of reactance four-poles
- RC-active circuits
- Synthesis of distributed circuits of grade two
- Empfindlichkeitstheorie
- Optimization of distributed circuits
- Switched Capacitor Filter

Thin Film Technology

Lecturer: Prof. Dr.-Ing. Norbert Fruehauf

Winter semester, 1 semester, Master's program. This lecture is only available in English.

- Introduction and overview
- Vacuum thin film technology: vacuum technology, vapor deposition, sputtering, plasma deposition, growth and properties of thin films
- Non-vacuum deposition: spin coating, printing, chemical deposition
- Materials for substrates and surface treatment
- Structuring of thin films
- Metrology

Flat Panel Displays

Lecturer: Prof. Dr.-Ing. Norbert Fruehauf

Summer semester, 1 semester, Electrical Engineering and Information Technology B.Sc. / Photonic Engineering M.Sc.

- Overview: cathode ray tubes, flat panel display technologies, current technologies
- Physiology of sight: color theory, CIE 1931 color space, color filters
- Fundamentals of liquid crystal technology: electro-mechanical properties, variation of the potential energy, twisted and non-twisted lc cells
- Light propagation in optically anisotropic uni-axial media: Jones vectors, Jones matrices
- Liquid crystal technologies: optical transmission through the Fréedericksz cell, vertically aligned and twisted nematic lc cells, surface stabilized ferro electric lc cells
- Control of lc cells: direct addressing, passiv matrix, active matrix

Optical Signal Processing

Lecturer: Prof. Dr.-Ing. Norbert Fruehauf

Summer semester, 1 semester, Master's program. This lecture is only offered in English.

- Mathematic description of optical signals and optical systems
- Analogue optical signal processing: Fourier-transformation of optical signals, optical filters
- Optical storage: CD, DVD, Blu-Ray, holography
- Optical sensors
- Digital optical signal processing

Organic Transistors

Lecturer: Dr. Hagen Klauk

Winter semester, 1 semester

- Overview: applications for organic transistors, economical considerations, realizations and general properties of organic transistors
- Electronic properties of conjugated carbohydrates: localized and delocalized molecular orbitals, energy of orbitals
- Electronic properties of organic solid state structures: crystalline structure, diesperion, charge transport in partially crystalline layers
- Structure and implementation of organic transistors: selection of materials, stack and processing
- Functionality of organic transistors: channel, carrier injection, band model, analytical description of the characteristics
- Frequency dependence of organic transistors: analysis and optimization of the frequency limit
- Applications for organic transistors: flat panel displays, integrated circuits

4.2 Exercises

Fundamentals of Electrical Engineering 1 and 2 – Lecture Exercises

Contact person: Dr.-Ing. Patrick Schalberger
Winter and summer semester, 2 semesters, Bachelor's program

Fundamentals of Electrical Engineering 1 and 2 – Group Exercises

Contact person: Dr.-Ing. Patrick Schalberger
Winter and summer semester, Bachelor's program
Winter semester compulsory for Electrical Engineering & Information Technology B.Sc. and Renewable Energies B.Sc.
Winter **and** summer semester compulsory for Mechatronics B.Sc.

Filter Synthesis Exercises

Contact person: Dr.-Ing. Patrick Schalberger
Winter semester, 1 semester, Master's program

Thin Film Technology Exercises

Contact person: Florian Kleber, M.Sc.
Winter semester, 1 semester, Master's program
The exercises are only available in English

Flat Panel Displays Exercises

Contact person: Dipl.-Phys. Marc Wilke
Summer semester, 1 semester, Electrical Engineering & Information Technology B.Sc. and Photonic Engineering M.Sc.

Optical Signal Processing Exercises

Contact person: Annika Schmekal, M.Sc.
Summer semester, 1 semester, Master's program
The exercises are only offered in English

4.3 Lab Courses

Lab Course "Fundamentals of Electrical Engineering"

The lab course is an inter-institutional course and takes place in the second semester (summer semester). It is compulsory for Electrical Engineering and Information Technology B.Sc. and for Renewable Energies B.Sc.

As the last year's lab course had to be postponed due to COVID-19, the experiment could take place in the summer semester as an online course and in the winter semester as a face-to-face course.

In addition to demonstrating and reinforcing basic concepts of electrical engineering, including "capacities as blocks to direct currents", "basic circuits with transistors", and "simple voltage dividers using resistors", the experiment "transistor-based amplifier" in the lab course is designed to teach practical experience in the implementation and testing of an amplifier cuircuit using bipolar transistors. The students will build the circuit, expanding it step by step and testing the behavior. The resulting circuit will feature a photo-transistor to create a infrared receiver. Using a transmission circuit also built during the experiment, an audio signal can be transmitted wireless.

Advanced Lab Course "Flat Panel Displays"

The lab course is part of the Master's program and takes place as an one-week block course during the first week after the end of lecture period in the summer semester.

This lab course "Flat Panel Displays" focuses on the building of a display for a digital clock. This display is based on a seven-segment display with liquid crystals, polarizers, implemented on glass substrates. All processing steps, including sputtering ITO, spin coating with photo resist and poluimide, photo lithography, wet chemical structuring, and cell construction are performed by the participants in the clean room at the Institute for Large Area Microelectronics. Finally, the display is connected to an IC to form a simple alarm clock. The participants can retain the clock they have built.

Advanced Lab Course "Optical Signal Processing"

The lab course "Optical Signal Processing" is part of the Master's program and takes place in the winter semester during the lecture period. Students will perform experiments on topics including:

- Spatial and temporal coherence
- Collimation (homogenous plane waves)
- Imaging and Refraction
- Diffraction
- Fourier Optics
- Design and production of synthetic holograms

4.4 Degrees

The following Bachelor's, Research and Master's theses were successfully passed in 2021:

Bachelor's theses

Simon Obermueller
Development of mixed-mode circuits of IGZO-TFTs

Felix Moehle
Assembly and Examination of Fast-Switching Liquid Crystal Cells

Rudolf Elenberg
Evaluation of photo patternable polymers with high aspect ratio for large area applications

Research theses

Sejal Kapinjal Mehta
Development of a backlight system for a MEMS shutter display

Ge Ge
Investigation of metal oxide TFTs for a MEMS shutter display

Research theses

Tanumita Haldar
Optimization of silicon nitride for the use in IGZO-TFTs

Hanghang Li
Design and Realization of IGZO Devices with Schottky Contact

Master‘s theses

Sneha Prahalad
Realization of a display addressing system based on a high voltage dribver chip

Jing Jiang
Manufacturing processes for thin film polarizers

Martin Roemhild
Investigation of Large Area Microelectronics Processes for Radio Frequency Applications and Packaging

5 Projects and Research Activities

Most research activities are third party funded. In addition to federal and European research grants, close cooperations with numerous industrial partners in Germany, Europe, but also in North America and Asia are important sources for funding and projects. Especially German companies profit from the extensive research activities at the Institute for Large Area Microelectronics allowing them to build their own know-how in the field of flat panel displays in a field that is otherwise dominated by companies from Asia.

6 Invited Talks and Conferences

March 2, 2021: Online-Keynote-Presentation at the Electronic Displays Conference
Prof. Fruehauf gave a keynote-presentation entitled "Active Matrix Arrays of Micro-Electro-Mechanical-Systems“ at the Electronic Displays Conference. The conference was held as a purely digital event in March 1-5, 2021.

June 30, 2021: Invited online-talk at the AM-FPD '21, Japan
Prof. Fruehauf gave an invited online-presentation entitled "Active Matrix Micro-Electro-Mechanical-Systems based Displays“ at the AM-FPD which took place as an online virtual event from June 29 to July 2, 2021 in Japan. The presentation has been created in cooperation with the co-authors S.A.Al Nusayer, Patrick Schalberger and Holger Baur.

7 Publications

Journals

February 26, 2021, Japanese Journal of Applied Physics:
Hydrogenated In-Ga-Zn-O thin film transistors with anodized and fluorinated Al2O3 gate insulator for flexible devices (Norbert Fruehauf and other authors)

8 Contribution to Organizations

- Chairman of the Board of Curators, Eduard-Rhein-Foundation, Germany
- Member of the Board of Curators, Institute for Microelectronics Stuttgart (IMS), Germany
- Regional Vice President Europe, SID Society of Information Display
- General Chair Eurodisplay 2021, SID Society of Information Display
- Member Active Matrix Committee, SID Society of Information Display
- Associate Editor, Journal of the Society of Information Display (JSID)
- Program Committee Member, AM-FPD, Japan
- Overseas Advisor, International Display Workshop (IDW), Japan

9 The Clean Room

The Institute for Large Area Microelectronics (IGM) possesses one of the largest university-based clean rooms for flat screen displays and similar systems in the world.

The facilities at the IGM include more than 500m^2 clean room space. The majority of that area or about 480m^2 are the main lab with a very high purity class for a research fertility (ISO5, less than 100 particles with a size of more than 0,5µm per cubic foot of air; ISO 4, less than 10 particles with a size of more than 0,5µm per cubic foot of air, in the area with the lithographic devices). The IGM is fully equipped to produce flat screens and similar thin film devices in near-industrial processes. The close similarity of the equipment and processes to industrial facility supports the technology transfer to industrial production lines.

A second, smaller clean room contains 3 MBraun glove boxes with a nitrogen inert atmosphere for the processing of organic semiconductors which are very sensitive to oxygen and humidity.

The following devices and facilities are available at the IGM:

Layer Deposition

- **PECVD:** The IGM features several PECVD reactors, including one Balzers (Oerlikon) KAI 1M reactor for the deposition of amorphous or poly-crystalline silicon (including doping), silicon nitrate, and silicon oxide on glass substrates up to 16 inches squared.
- **Sputtering:** Two Leybold ZV6000 inline-sputtering systems equipped with a total of 12 different targets (9 DC and 3 RF) are available at the IGM. Targets for typical display materials like chromium, aluminium, molydaenium but also gold, nickel, palladium, ITO, AZO, IGZO are available. Numerous additional targets can be mounted as necessary. The sputter system can handle substrates of up to 16 inches squared.

  The first ZV6000 sputtering-system had been fundamentally refurbished in 2017. In 2020, together with the company HS-Group GmbH, we had been able to perform the modernization of the second sputtering-system as well. Now, both systems are state-of-the-art regarding to PLC system control, user interface, gasflow control, pressure measurement/-control and substrate transport drive. This enables new possibilities for deposition

process optimization and allows for a long term perspective of operating the machines.

- **Vapor Deposition:** The IGM offers access to a Lesker Spectros vapor deposition system with two separate sources for metallic material and eight sources for organic material. The system is integrated into the inert-gas glove boxes to enable oxygen and moisture free handling of OTFTs and OLEDs. In addition, the IGM features two older Balzers systems with thermal and electron beam vaporization systems. All vapor deposition systems can handle substrates of up to 6 inches squared.
- **Spin Coating:** The IGM operates several spin coaters for the deposition of photo resist and other liquids onto substrates of up to 16 inch squared. One smaller spin coater for substrates of up to 6 inches squared is integrated into the inert-gas glove boxes.
- **Printing:** Several printers for the direct deposition of structured layers are accessible at the IGM. Screen printers allow the large area deposition of material at a high volume but require a specifically made screen as a mask. A Dimatix inkjet printer can deposit almost any solution or suspension without the need for a complex physical mask. Additionally, the new XTPL DELTA Ultra-Precise Deposition (UPD) printing system enables digital printing of highly precise patterns with linewidths below five microns at simultaneously high film thicknesses of several hundred nanometers. This allows for many new applications in the field of printed electronics, packaging or defect repair in thinfilm circuitry.

Photo Lithography

- **Lithography with Photo Masks:** The IGM is equipped with two contact exposure systems of type Süss MA6 for processing substrates of up to 6 inches squared. This allows for the realization of structures down to 3µm.
- **Direct Imaging:** The IGM features a Heidelberg Instruments DWL 400 direct imaging system that can realize structures down to 2µm on 16 inch squared substrates without requiring complex photo masks.

Layer Modification

- **Ion Implantation:** Access to an ion implantor type Eaton (Axcelis) NV3206 is offered at the IGM. The standard airlock has been replaced with a larger one allowing the processing of substrates up to 16 inches squared. The system can implant phosphorus, boron, fluor, and argon ions at up to 200kV.

- **Excimer-Laser:** A Sopra VEL Excimer Laser for the recrystallization of amorphous into polycrystalline silicon is available at the IGM. The XeCl laser operates at a wavelength of 308nm and can fire 200ns pulses of up to 15J each at a target area of 67mm by 27mm. It can also be used to activate doping or to improve the crystal quality of other semiconductors. The system can process substrates of up to 16 inches squared using stitching.
- **UV-Ozone Treatment:** The IGM features a UV-Ozone system to clean substrates or to improve surface adhesion. The combination of highly reactive ozone and high energy light can remove organic contaminants and can activate the surface by freeing chemical bonds in surface molecules. The system can process substrates of up to 16 inches squared.

Liquid Crystal Technology

- **Rubbing:** The IGM offers access a Hörnell Rubbing system to structure the polyimide orientation layer by rubbing with a velvet roll.
- **Spacer Spray System:** The IGM operates an electrostatic spacer spray system type Accudyne for 5µm spherical polymer spacer used to ensure a uniform thickness of the liquid crystal cell. Additional different sizes of spacers can be sprayed or spin coated.
- **Glue Robot:** A Schiller 3-axis (xyz) gantry robot is used to apply glue frames in the assembly of the two substrates into one liquid crystal cell.
- **Filling Chamber:** The IGM utilizes a dedicated Balzers vacuum chamber with a movable substrate holder to fill cells with liquid crystals.
- **Cell Construction:** The IGM featurs a wide array of additional tools supporting the micrometer alignment of sustrates.

All of the above systems can handle substrates of up to 16 inches squared.

Metrology

- **Waferprober:** A Süss wafer prober in combination with a Keithley 4100 semi conductor measurement system allows for the reliable characterization of TFTs and other semiconductor electronic elements. Additional picoampere meters allow measurements in the clean room, in climate boxes and in intert-gas boxes.
- **Viewing Angle Contrast Measuremen:** An Eldim EZ Contrast 160 system is used for high-speed measurements of luminance, contrast and color space of transmissive and reflective or self-illuminating displays both in absolute values and their viewing angle dependency.

- **Climate Chamber:** A climate chamber allows for the controlled exposure to precisely definite environments, facilitating the evaluation of systems under different conditions and the simulated aging at increased environmental temperatures.
- **Optical Microscopes:** Several optical microscopes allow for quick inspections of processed substrates. Substrates of up to 16 inches squared can be checked.
- **Scanning Electron Microscope:** For inspections at resolutions above the limits of optical microscopes the IGM features a JEOL JSM 6100 SEM. This system has been modified for digital image generation.
- **Atomic Force Microscope:** The IGM features a DME AFM to determine surface topologies and surface roughness of layers.

Bonding

- **TAB Bonder:** Several TAB (Tape Automated Bonding) devices, both manual and semi-automatic, are available for bonding chips on foil (COF) driver chips onto glas substrates using anisotropically conductive adhesive film.
- **Flip-Chip Bonder:** Unmounted silicon chips can be bonded upside-down (flip-chip) directly onto display glas. This technique saves space on the substrate and is therefore well suited to tablet and smartphone displays. The IGM operates a Süss flip-chip bonder.

10 IGM-Activities

10.1 XTPL® DELTA Ultra Precise Deposition Printing System

In spring 2021 the worldwide first delivered XTPL® DELTA Ultra-Precise Deposition Printing System had been put to operation in the cleanroom laboratory of the Institute for Large Area Microelectronics (fig. 1)

Fig. 1: XTPL® DELTA Ultra-Precise Deposition Printing System in the clean-room of the Institute for Large Area Microelectronics

The Delta Printer is a system that enables digital printing of highly precise patterns with linewidths below five microns at simultaneously high film thicknesses of several hundred nanometers. This allows for many new applications in the field of printed electronics, packaging or defect repair in thinfilm circuitry. One example is printing of high resolution conductive patterns (fig. 2), e.g. drain/source patterns of organic thin film transistors. This enables improving the current driving capabilitiy of the transistors by shorter channel length, reducing the area consumption and therefore improving resolution or aperture of rinted active matrix displays.

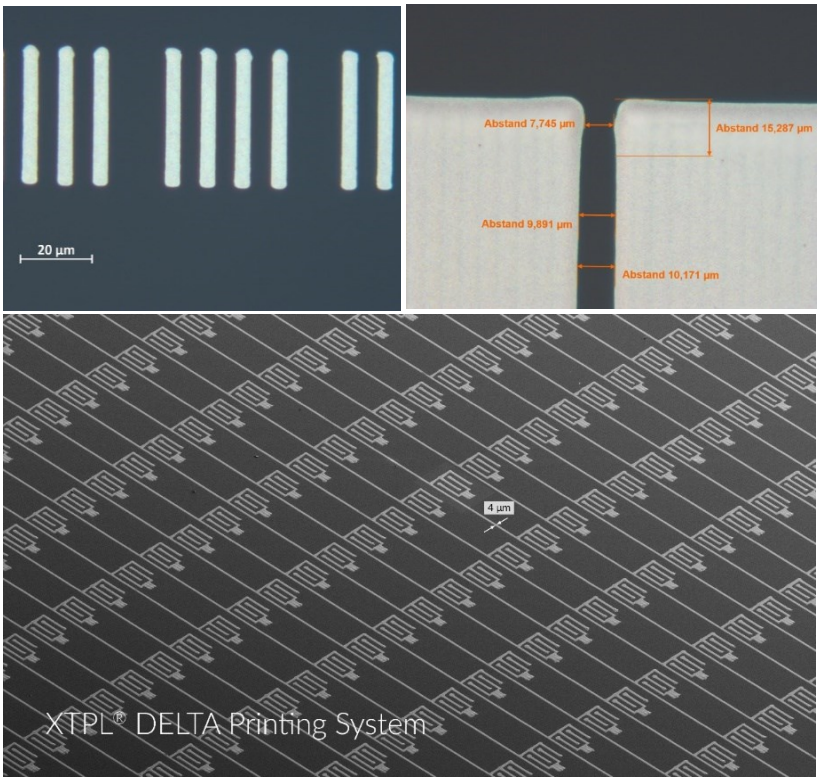

Fig. 2: Printing of high resolution conductive patterns

10.2 Eurodisplay 2021

The Eurodisplay is Europe's most important scientific conference on information displays and related topics attracting scientists and engineers from all over the world.

Due to the ongoing COVID-19 pandemic the Eurodisplay 2021 had to be postponed by another year. The Eurodisplay 2022 will take place from 21st to 23th September 2022 in Stuttgart-Vaihingen, Germany at the campus of the University of Stuttgart.

10.3 LG Display Co. acquires license for an IGM invention

In February 2021, LG Display Co. acquired a license for the active-matrix-drive circuit for OLED displays invented by the Institute for Large Area Microelectronics (IGM).

Displays equipped with OLED technology offer an excellent picture quality with strong contrast and rich colors. Almost all of the OLED televisions sold millions of times worldwide by LG and other leading manufacturers, such as Sony and Panasonic, use the LG OLED display modules and thus the invention of the Institute for Large Area Microelectronics at the University of Stuttgart.

The University of Stuttgart had sold the patent to Solas OLED Ltd. which successfully sued LG and other manufacturers of OLED televisions for patent infringement. After several litigations, LG Display Co. acquired a license for the invention made at the Institute for Large Area Microelectronics. The institute was participating in the licensing proceeds.

10.4 New Research Training Group

To utilize the great potential of quantum physics for marketable applications – this is the overarching goal of the new Research Training Group "Towards Graduate Experts in Photonic Quantum Technologies" at the University of Stuttgart which was approved for funding by the German Research Foundation (DFG)

The Institute for Large Area Microelectronics participates with a successfully staffed PhD position in the research topic "Electrical readout of a nitric oxide trace-gas sensor based on Rydberg excitation".

10.5 Girls‘ Day

With the slogan "We want to show you that experimenting, doing research and building are not just for boys!", the IGM participated in the Girls‘ Day with the topic "Mobilephone, Laptop & Co., how does a display actually work". The Girls’ Day of the University of Stuttgart was held as a digital event on April 22, 2021.

The schoolgirls got an insight how a display works: from the light ray to the physics up to the control. Each element was demonstrated in a small practical experiment. The schoolgirls could perform some of the experiments by themselves at home, such as building their own touchpad prototype.

All participants had much fun and the Institute for Large Area Microelectronics was happy to get a lot of positive feed-back!

10.6 Institute Excursion

The annual institute excursion is postponed to next year due to COVID-19.

10.7 Christmas Party

The Christmas Party could not take place due to the pandemic situation.

11 Directions and Maps

By car

Leave the highway "Autobahn A8" at the interchange "Autobahnkreuz Stuttgart-Vaihingen" and take the A831 / B14 in the direction of Vaihingen. Leave the B14 after the tunnel (careful: speed trap!) at the exit "Universität". At the traffic light turn left. Stay on "Universitätsstrasse" and later turn right into "Pfaffenwaldring". Then turn left into "Allmandring". Take the first entrance on the left and park your car on the university parking place. Now you only need to walk a few steps to the Institute of Large Area Microelectronics (IGM).

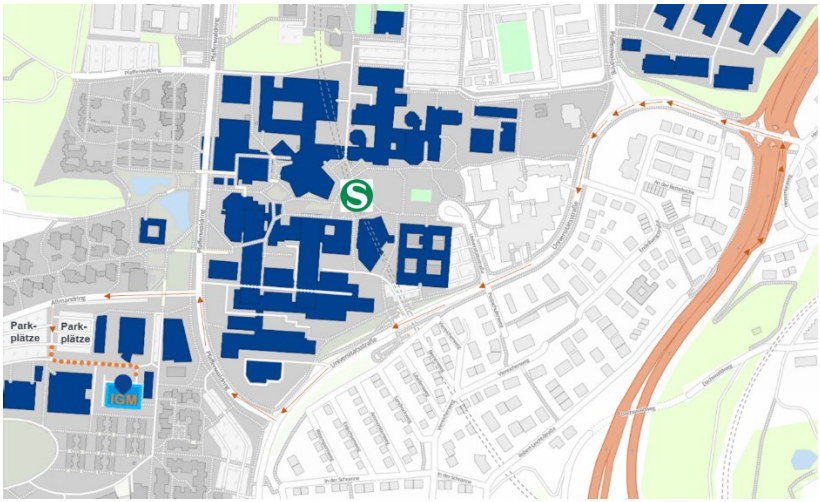

Fig. 3: By car to the Institute of Large Area Microelectronics

By public transport

Upon arrival at Stuttgart Main Station move towards the lower platforms (S-Bahn, green "S" as a logo). If you do not have a valid ticket for the S-Bahn to "Universität/University" you will need to get a ticket at one of the red ticket machines located near the top of the escalators down to the lower platforms. You will need a one-zone ticket. Choose your language, press the "VVS button" and then "1 zone". You will now be asked to choose between a "single-ticket" (one-way ticket) or a "4-journey-ticket" (multi-ticket usable for four trips). The "4-journey-ticket" has to be devalued before entering the train (small orange boxes).

Take one of the below S-Bahn trains at platform 101:

- S1 direction Herrenberg
- S2 direction Filderstadt
- S3 direction Flughafen

The S-Bahn comes every 5 to 20 minutes, depending on the time of day. Alight at the stop "Universtität/University" (about 10 minutes trip) and follow the way from the S-Bahn station to the Institute for Large Area Microelectronics (IGM). Please find a detailed way description on our website.

By plane

Upon arrival at the Stuttgart Airport you will exit the gate on level 1 (lower level). Go to the S-Bahn train station one level lower, marked with a large, green "S" logo. You will need to get a ticket at one of the red ticket machines located near the top of the escalators down to the lower platforms. You will need a two-zone ticket. Choose your language, press the "VVS button" and then "2 zones". You will now be asked to choose between a "single-ticket" (one-way ticket) or a "4-journey-ticket" (multi-ticket usable for four trips). The "4-journey-ticket" has to be devalued before entering the train (small orange boxes).

Take one of the below S-Bahn trains

- S2 direction Schorndorf
- S3 direction Backnang

and exit at S-Bahn station "Universtität/University" (about 17 minutes trip). Then follow the way to the Institute for Large Area Microelectronics (IGM). Please find a detailed way description on our website.

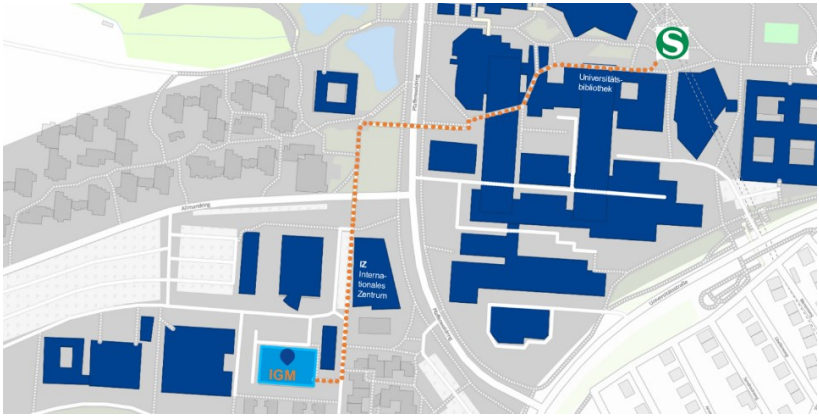

Fig. 4: Sidewalk from S-Bahn station University to IGM

12 Contact

You can contact us at:

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