Tampere University

FutureChips

Postdoc Programme

Dr. Pauli Kuosmanen
Director
Research and Innovation Services

Co-funded by
the European Union

Programme 10:30-11:30 EEST

- Welcome and introduction to Tampere University **Pauli Kuosmanen**
- FiCCC + Chips from Tampere **Petri Räsänen, Pasi Pylväs**
- FutureChips - the open call **Jörg Langwaldt**
- Research theme 1: Advanced compound materials and heterostructures
  - **Mircea Guina** Optoelectronics Research Centre
  - **Goëry Genty** Ultrafast Photonics
- Research theme 2: Novel Architectures
  - **Sayani Majumdar** CMOS and Beyond
- Research theme 4: Advanced packaging
  - **Matti Mäntysalo** **Electronics research centre**
  - **Juha Toivonen** **Applied Optics**
- 11:25-11:30 QA and Closure

Tampere University

Introduction to Tampere University

Tampere University

Tampere, Finland

- Tampere is a vibrant, clean and safe city. It consistently tops surveys as the most desirable city to live, study and do business in Finland.
- With a population of 260,000, Tampere is Finland’s third-largest city. One in every five residents is a student in secondary or higher education.
- Tampere is internationally recognised as one of the world’s top five semiconductor hubs and a major European chip design and photonics cluster.

Tampere University in brief

Multidisciplinary, the 2nd largest university in Finland

7 faculties

10 fields of education

Our locations:

Tampere
Seinäjoki
Pori

23,200 students
105 nationalities
9% internationals

4,400 employees
83 nationalities
21% internationals

Our focus areas:

Technology
Health
Society

5,100 degrees per year

Operating revenue

390 M€

Research and development funding

119 M€

We work together to build a sustainable world.

We aim for **carbon neutrality** and promote **nature positivity**

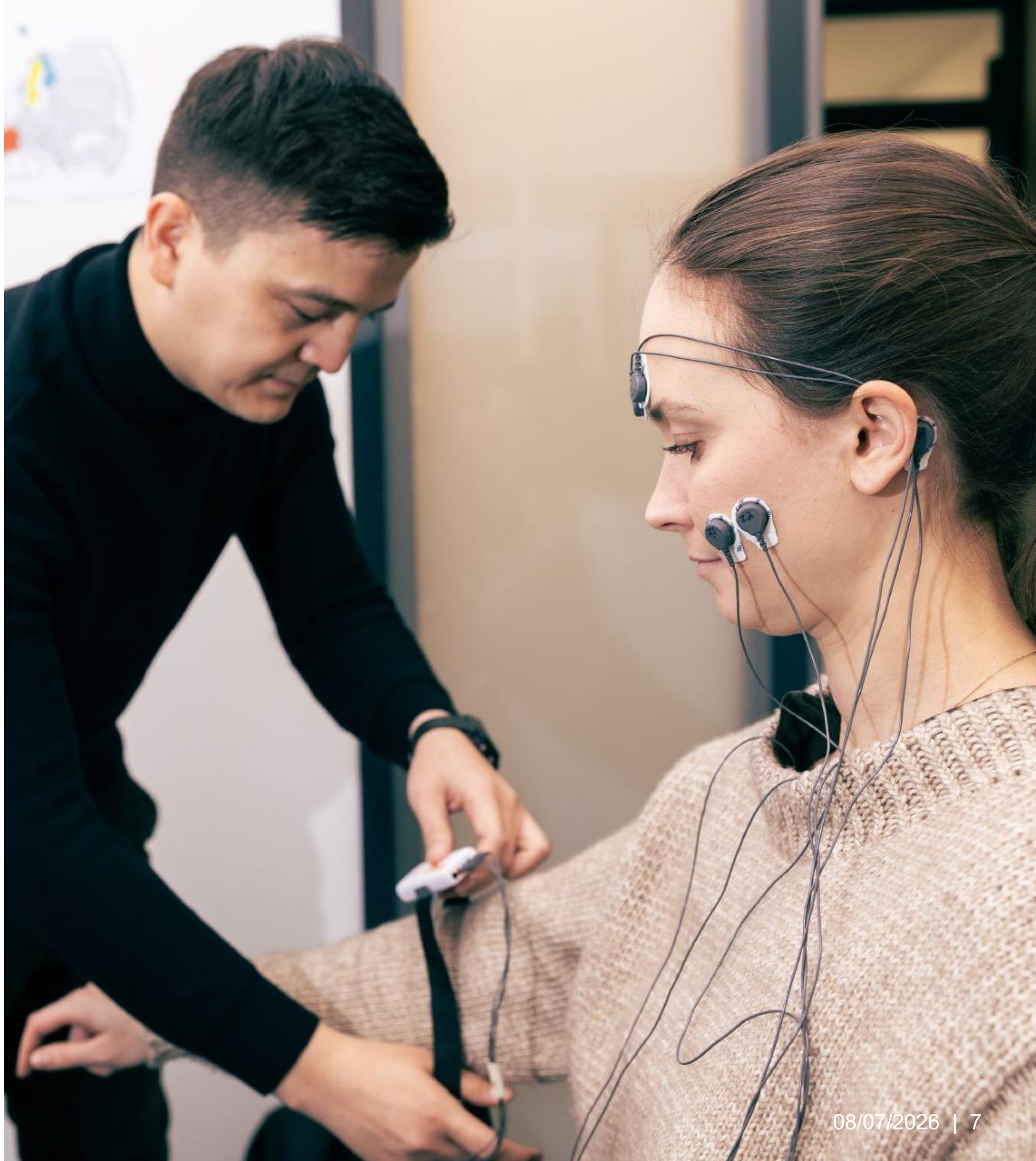
Tampere University

Our international strategy 2030

A thriving university community	An internationally esteemed research university	An educator of world-changing experts	A strong partner and active societal influencer
1. We are a diverse and inclusive community that promotes participation and provides equal opportunities for everyone to succeed 2. Everyone has the opportunity to internationalise 3. We follow open recruitment practices to attract the most qualified candidates 4. Our international staff and students commit to and engage with the University and Finnish society	1. We lead international research 2. We are a European university 3. We promote the global utilisation of research-based knowledge	1. Internationality is integrated into all our degree programmes 2. Our degree programmes are of high quality and are delivered responsibly	1. We have a strategic approach to internationalisation 2. We make an international impact together with our stakeholders 3. Our international cooperation is responsible

Wide-ranging research across disciplinary boundaries

- Our key strength is research in the fields of **technology**, **health** and **society**.
- We conduct research responsibly and actively promote open science.
- State-of-the-art research infrastructures are an integral part of our research environment.



Collaborative R&I: TAU is #14 in Pillar 2 RIA/IA

Horizon Europe collaborative research and innovation actions

14. TAU

Collaborative R&I projects

This is TAU's highest relative ranking among the selected Horizon Europe views.

Interpretation

The collaborative portfolio places TAU in the leading European university peer group.

Benchmark leaders

1.	KU Leuven
2.	TU Delft
3.	DTU
4.	Aarhus
5.	Gent
14.	**TAU**

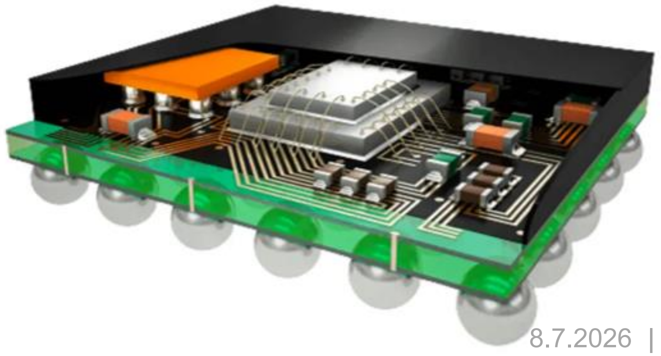
Finnish peers (top): #27 Oulu · #33 Helsinki · #50 Aalto

Full ranking context remains on the detailed comparison slide.

TAU – Chips JU

- Chips Act Large Pilot lines:
  - Advanced Wide Bandgap Semiconductors – System-in-Package Fab
- EU Design Platform (EuroCDP):
  - Develops chip design support for European Industry, especially SME's and startups
  - IMEC; CEA/LETI, Fraunhofer, …
- Finnish Chip Competence Center:
  - Strengthen the Finnish Chips expertise
  - Tampere, Espoo, Oulu, Joensuu

- Design Enablement Team:
  - Chip Design Team: TAU, CoreHW, VLSI Solution, VTT, Chip Fusion
- EuroCDP FSTP:
  - Support for start-ups and SMEs making use of the Design Platform (220M€ EU + national funding)



Tampere University

Semiconductor research

We coordinate:

- PREIN – Flagship on Photonics Research and Innovation
- Key contact goery.genty@tuni.fi and mircea.guina@tuni.fi and juha.toivonen@tuni.fi

We are partners in:

- **System-on-Chip Hub research centre**
- Key contact timo.hamalainen@tuni.fi
- **System-in-Package Fabrication (SiPFAB) EU-pilot line for wide bandgap (WBG) chip packaging**
- Key contact jukka.viheriala@tuni.fi and sayani.majumdar@tuni.fi

Human
Potential
Unlimited.

Chips from Tampere 1-2

From Pillar 1 in ECA1 to Pillar 2 in ECA2

Petri Räsänen
Senior Director
Business Tampere Ltd.

petri.rasanen@businesstampere.com

TAMPERE

TAMPERE. FINLAND

Chips from Tampere - phase 1

FiCCC, Finnish Chips Competence Centre established

WPs and objectives 2023-25

WPs and objectives 2026-27

Ecosystem visibility & development

Development of Chip Act operational models

Strategic project roadmapping

Policy influence and EU collaboratíon, Chips from Finland

Chips Competence Centre for Finland

EU Design Platform & Centre of Excellence plan

EU Pilot line concept and plan

FI matching funding

International partnerships

TAU in the EU Design Platform consortium

TAU is the packaging partner of the WBG-Pilot Line

BF co-funding and chip campaign secured

EU, Austin (TX), Taiwan, Japan, Singapore

New design centers & startups

Hybrid System-in-Package Fabrication (SiPFAB)- pilot line

Application specific microelectronics & photonics SiP capability

Industrial fabrication investments

EU Chips Strategy / FI Chips from the ... U WP / Nokia 5&6G Roadmap / SoC HUB + SiPFAB Roadmaps...

BUSINESS TAMPERE Region

TAMPERE. FINLAND

Chips from Tampere – phase 2

FiCCC, Finnish Chips Competence Centre established

WPs and objectives 2023-25		WPs and objectives 2026-27	
Ecosystem visibility & development	Chips Competence Centre for Finland	EU Chips Act 2	New design centers & startups
Development of Chip Act operational models	EU Design Platform & Centre of Excellence plan	Industrial investments	System-in-Package Fabrication (SiPFAB)- pilot line
Strategic project roadmapping	EU Pilot line concept and plan	Talent development	Application specific microelectronics & photonics SiP capability
Policy influence and EU collaboratíon, Chips from Finland	FI matching funding	Ecosystem co-op	Industrial fabrication investments
	International partnerships		

TAU in the EU Design Platform consortium

TAU is the packaging partner of the WBG-Pilot Line

BF co-funding and chip campaign secured

EU, Austin (TX), Taiwan, Japan, Singapore

EU Chips Act 1-2 / FI Chips from the North Strategy / Chips JU / Nokia 6G & AI Roadmap / SoC HUB + SiPFAB Roadmaps…

BUSINESS TAMPERE Region

Tampere Chip ecosystem

FiCCC
The Finnish Chips Competence Centre

- The Finnish Chips Competence Centre FiCCC brings together top experts in the field and accelerates digitalization across industries. FiCCC supports the development of competitive chips and operates from Tampere University.
- The Tampere region is among the world’s top 5 semiconductor hubs and a major European chip design and photonics cluster.
- Tampere has developed a strong cluster of companies focused on photonic systems, semiconductors, and laser technology, the “Laser Valley.”
- The region hosts 17 semiconductor companies.
- Over 500 professionals in chip design work in Tampere.
- Nokia is one of the largest users of advanced chips in the EU, and a significant portion of its chip development is located in Tampere.
- Europe’s leading design service company, Nordic Semiconductors, is in Tampere.

FutureChips

Next-generation semiconductor technologies

Postdoctoral Programme

Horizon Europe - Marie Skłodowska-Curie Action

Contact us: futurechips@tuni.fi

FutureChips webpage https://projects.tuni.fi/futurechips/

Call is open until 31 August 2026

- 12 postdoctoral fellowships (36-month) for next-generation semiconductor technologies implemented at:
  - Faculty of Engineering and Natural Sciences
  - Faculty of Information Technology and Communication Sciences.
- 1st **call** for applications (12 fellowships) is open from **July 1 to August 31, 2026**.
- Applicants propose their **preferred specific research project fitting** to one of the four research areas of FutureChips
  - **1. Advanced compound materials and heterostructures, 2. Novel architectures, 3. Chip design, 4. Advanced packaging**
- Based on the **<u>selected Research area</u>**, the **<u>applicant select the primary academic supervisor</u>** (ie research group leader) listed for the corresponding FutureChips research area.
- Monthly gross salary before taxation €4500 after taxation about €3100.

Tampere University

Visit the FutureChips webpage

Co-funded by the European Union

FutureChips

Next-generation semiconductor technologies

SEARCH...

HOME ABOUT RESEARCH AREAS SUPERVISORS RESEARCH INFRASTRUCTURE HOW TO APPLY SUOMEKSI

FutureChips

FutureChips is a new postdoctoral programme at Tampere University offering 20 excellent researchers a 36-month fellowship in the field of next-generation semiconductor technologies.

The first call for applications (12 fellowships) will be open from July 1 to August 31, 2026. Fellows are expected to relocate to Tampere and to start their fellowship in July 2027.

Four research areas:

1. Advanced compound materials and heterostructures

2. Novel architectures

3. Chip design

4.Advanced packaging

23 Academic Supervisors

- **Theme 1: Advanced compound materials and heterostructures**
  - Prof Robert Fickler
  - Prof Goery Genty
  - Prof Mircea Guina
  - Prof Regina Gumenyuk
  - Prof Laeticia Petit
  - Prof Mika Valden
- **Theme 2: Novel Architectures**
  - Asst. Prof Mohsin Abbas
  - Prof Robert Fickler
  - Adj. Prof Mikko Huttunen
  - Prof Pekka Jääskeläinen
  - Asst. Prof Sergey Kruk
  - Prof Sayani Majumdar
  - Assoc. Prof. Tapio Niemi
  - Prof. of Practice Markku-Juhani Saarinen
- **Theme 3: Chip design**
  - Asst. Prof Mohsin Abbas
  - Prof Timo D. Hämäläinen
  - Prof Pekka Jääskeläinen
  - Asst. Prof Alexandre Mercat
  - Prof Karri Palovuori
  - Prof. of Practice Markku-Juhani Saarinen
  - Asst. Prof Vishnu Unnikrishnan
  - Prof Mikko Valkama
  - Prof Jarno Vanne
  - Asst. Prof Han Zhou
- **Theme 4: Advanced packaging**
  - Prof Matti Mäntysalo
  - Prof Juha Toivonen
  - Assoc. Prof Jukka Viheriäläha

Tampere University

Co-funded by the European Union

FutureChips

FutureChips

Next-generation semiconductor technologies

SEARCH...

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https://projects.tuni.fi/futurechips/

Mircea Guina

Briefly

Prof. Mircea Guina (Semiconductor Technology): >750 publications, h-index 40, >10 patents, supervised 16 postdocs, >25 PhD candidates. ERC grantee. He has mentored several entrepreneurial teams and he co-founded three deep tech spinoffs related to semiconductor technology: Vexlum, Picophotonics and Reflekron, all located in Tampere. Innovation professor of the year award (2023).

Research outputs and activities of the Supervisor

→ TUNICRIS Research portal

→ Open Researcher and Contributor ID

Research group

Optoelectronics Research Centre (ORC) is the only European group with leading fabrication expertise across all key materials used in optoelectronics, i.e. GaAs, InP, and GaSb material systems. The group has been at the frontier of optoelectronics research in Finland and Europe for more than 30 years, capitalizing on an outstanding range of fabrication processes and characterization expertise.

Research infrastructure

Essential to the success of ORC is the operation of 3 MBE reactors (for synthesis of GaAs-, InP-, and GaSb-based compounds) and complete optoelectronic device processing and characterization lines, including state-of-the-art equipment for coatings, metallization, and lithography, as well as static, spectral, and high-speed modulation characterization. TAU has made significant investment in directly supporting infrastructure related to photonics research and material science in general. The entire infrastructure at TAU related to photonics and advanced lean-room environments (class ISO5 and ISO7) is part of the FinnLight National Infrastructure (https://finnlight.fi), which enables access to a comprehensive combination of technologies covering all classes of photonics materials and process lines for device fabrication. It also offers state-of-the-art possibilities for material investigations at nanoscale.

Application - Requirements

- Applicants must:
- **have not** resided or carried out their main activity (e.g. work, studies) in Finland for more than 12 months in the 36 months immediately preceding the application deadline (31 August 2026).
- have a **doctoral degree** in a relevant field (e.g. future electronics, electrical engineering, photonics, micro- and nanotechnology, semiconductor physics, advanced materials, or chip design) by the application deadline of 31 August 2026. Applicants who have successfully defended their doctoral thesis by 31 August 2026, but who have not yet formally been awarded the degree are also eligible to apply. In such cases, the applicant must provide confirmation that the doctoral degree will be awarded at the latest upon starting the employment.
- have the ability to pursue independent scholarly activity.
- have fluent spoken and written English skills.

Tamper University FutureChips

Application – Submission documents

- **Doctoral degree certificate**
- **Application** using the template and containing:
  - **Research Plan Abstract**
  - **Research Plan** within any of the four research areas of FutureChips
  - **Curriculum Vitae**
  - **List of publications**
  - **Ethics self-assessment**
  - **Motivation letter**

Applications are submitted in the LAURA-system. See the Open Position description, the Guide for Applicants and the Application template.

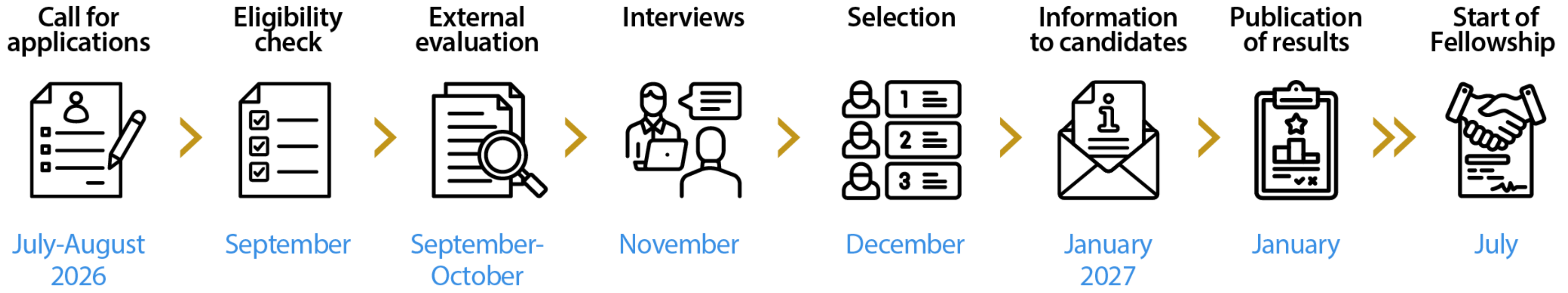
Evaluation and selection

The applicant will be evaluated based on:

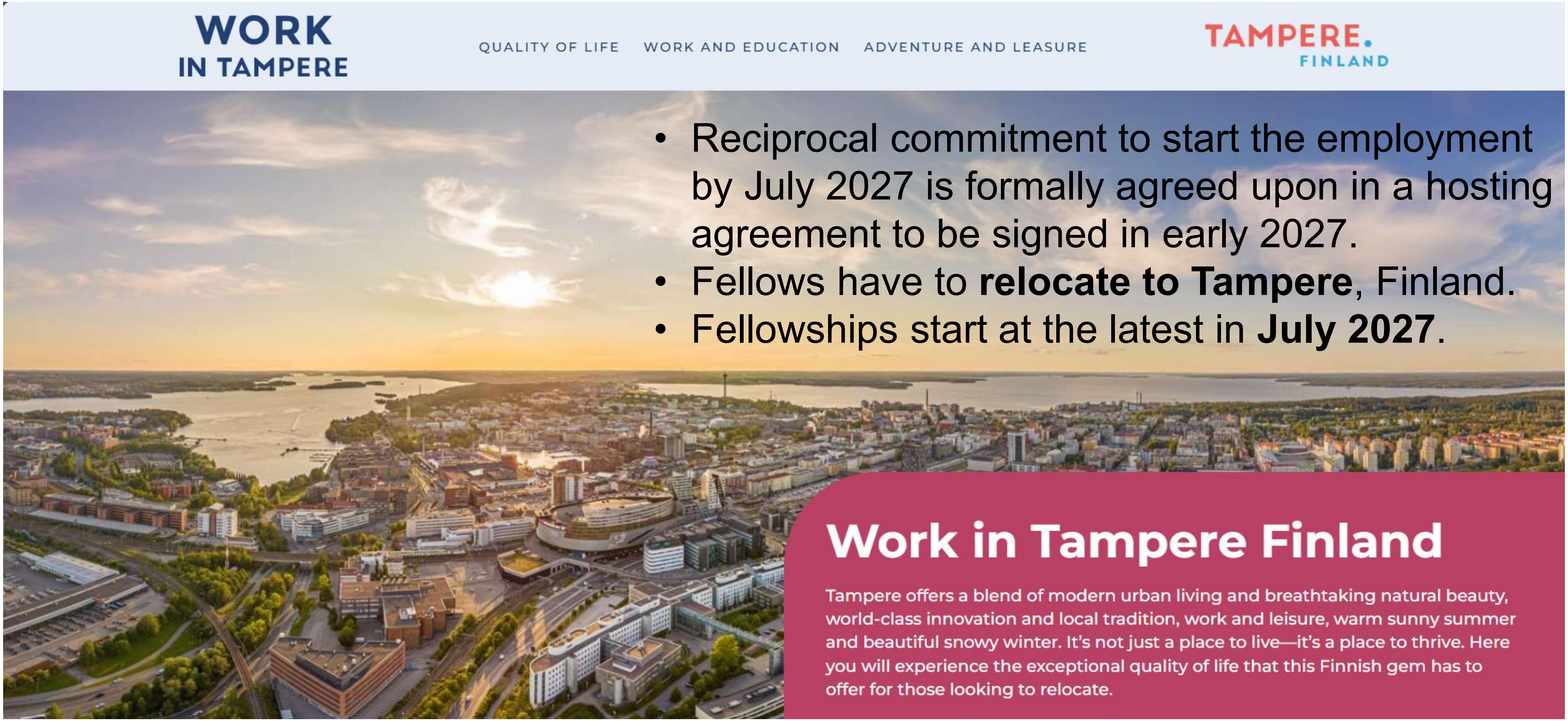
- the applicant's academic merits and demonstrated excellence,
- the quality and scientific excellence of the research proposal,
- the feasibility, impact, and implementation of the research proposal,
- the scientific relevance and significance of the proposed research topic,
- communication and dissemination skills.

- Check: Match of the Research plan with the Research area and academic supervisor, required versus available Research infrastructure

Evaluation and selection



- Each eligible application is evaluated by three independent experts.
- Applications are ranked by scoring.
- The highest ranked will proceed to online interviews.
- Online interviews (25 min) in November, 9.–20.
- Ethics screening.
- Rebuttal opportunities based on procedural errors or factual inaccuracies.
- Recruitment decision at the end of 2026.



- Reciprocal commitment to start the employment by July 2027 is formally agreed upon in a hosting agreement to be signed in early 2027.
- Fellows have to **relocate to Tampere**, Finland.
- Fellowships start at the latest in **July 2027**.

[Home – Work In Tampere](#)

Relocation services

- Guide for New International Researchers and Their Families
  - Relocation Guides and International Service Points | Formalities | Finnish Culture and Language | Practicalities | Health Care | Finnish Work Culture | Diversity and Inclusion in Academia | Spouses | Families with Children | Cultural Events and Hobbies | Contributor
- Relocation guide to Tampere
- International House Tampere
  - International Service Points at city of Tampere host the regional international house
- Tampere University as an employer
- Moving to Tampere
- Working and living in Tampere

More about Finland, Tampere and TAU

- Visit Finland
- This is Finland
- Ministry of Economic Affairs and Employment: Welcome to Finland
- Visit Tampere
- Work in Tampere
- Working at Tampere University
- Tampere Higher Education Community - our academic playground.
- FutureChips

Programme 10:30-11:30 EEST

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  - **Juha Toivonen** **Applied Optics**
- 11:25-11:30 QA and Closure

Tampere University

Professor Mircea Guina

Optoelectronics

ORCID 0000-0002-9317-8187

Physics:
Photonics

Professor at the **Faculty of Engineering and Natural Sciences** in the Physics unit, head of ORC research group.

- **Research focus:** Development of optoelectronic devices, III-V semiconductor technology, and photonic integrated systems
- **Expertise in:** molecular beam epitaxy (MBE), semiconductor technology, laser physics, optoelectronic devices and related applications in photonic systems.
- **Collaboration offering:** comprehensive development of novel optoelectronic devices, including advanced semiconductor lasers and detectors for applications in sensing, medicine, communication, and security; MBE fabrication of III-V compounds.

Keywords:
Optoelectronics; Molecular Beam Epitaxy; Photonic Integration; Semiconductor lasers and detectors

mircea.guina@tuni.fi
+358 (0)40 849 0004

Page updated: 02.03.2026

Tampereen yliopisto
Tampere University

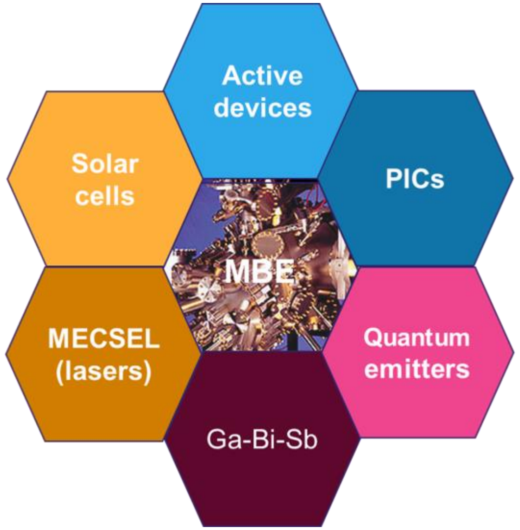
Future Chips

Topic 1: advance compound materials and heterostructures

Prof. Mircea GUINA

Faculty of Engineering and Natural Sciences

Tampere University, Finland
e-mail: mircea.guina@tuni.fi
LinkedIn: @mircea-guina

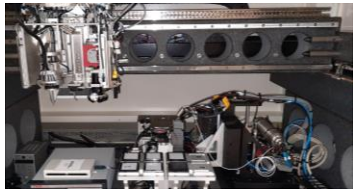


Tampereen yliopisto
Tampere University

Vertically integrated optoelectronics fabrication

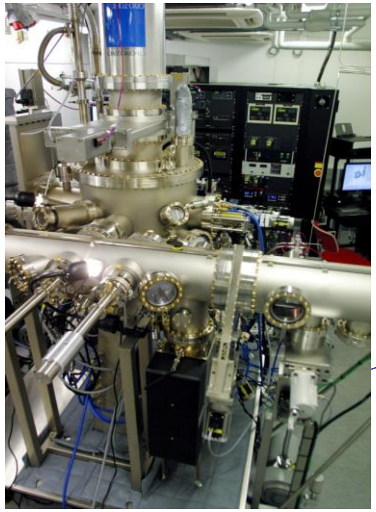
https://research.tuni.fi/orc/


- Flip-chip bonding
- Wire bonding
- Bond validation
- Solder deposition



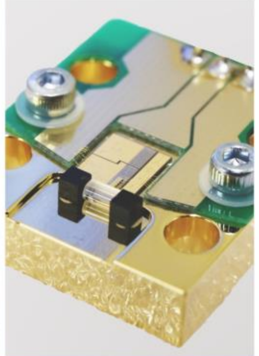
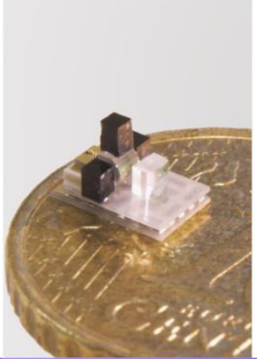
- 3D-micro assembly
- Optical coatings

- UV Lithography
- NIL
- Etching
- Metal deposit
- Insulators
- Wafer bonding
- Electron beam lithography
- Microscopy / Profilometry



MBE technology
40 years legacy



Wafer fabrication

ORC

Wafer level processing and packaging

Chip level packaging

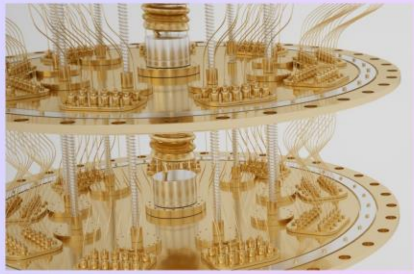
Module sub-assembly

External chip fabs

Key materials: GaAs, InP, GaSb

System level
Customer applications

LIDAR	Enviromental sensing
Datacom	Quantum technology
Solar energy	Biomedical technology
Imaging	Process monitoring



Tampere University

Current research topics

(2026)

GROUP

~ 20

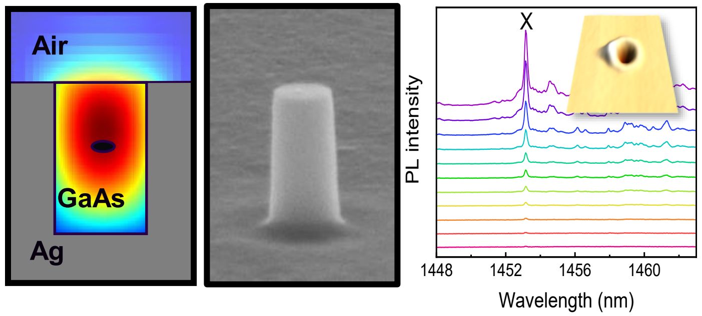
Co-Pi Dr. T. Hakkarainen
Co-Pi Prof. J. Viheriälä (ITC)
PostDocs: J. Hilska, H. Tuorila

8 PhD students
- 2 finalizing in 2026
6 MSc students
4 BSc students

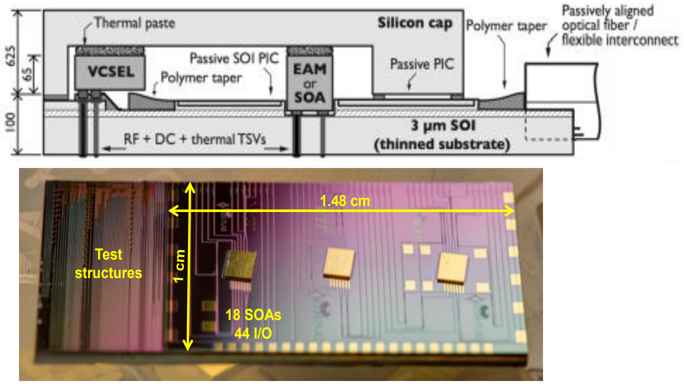
ENRE support
Senior Scientists:
A. Tukiainen, A. Vlasov

Laser diodes, SLEDs, & VCSEL

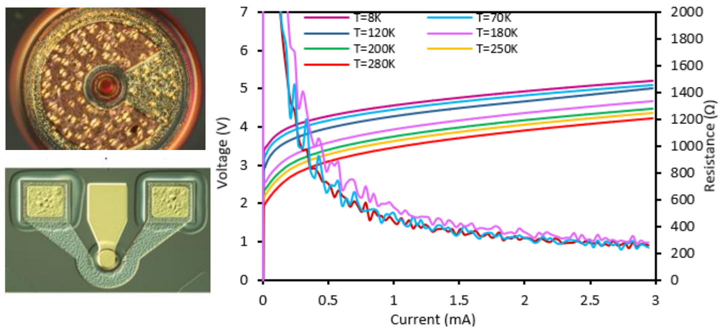
Quantum light sources



Photonic integrated circuits (PICs)



Cryogenic optoelectronics



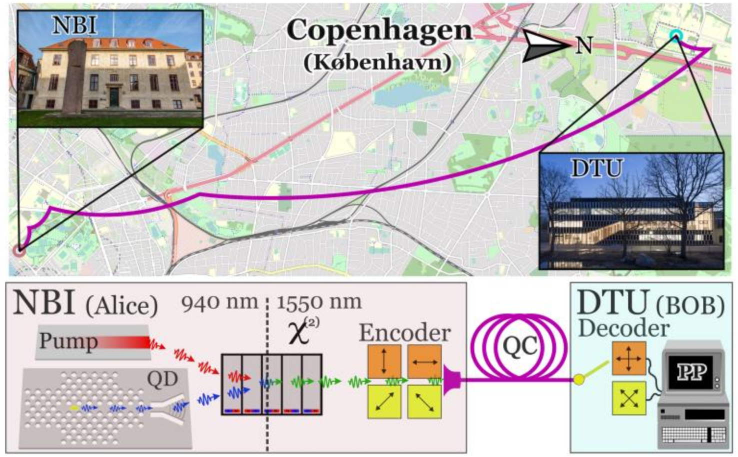
RAVEN
Ultra high resolution atmospheric sensors

PhotonMed
Pilot Line for Photonics-Based Medical Devices

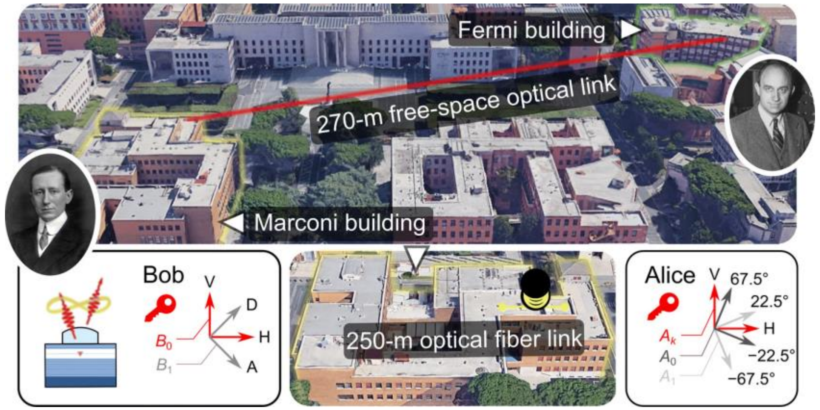
Quantum sources based on GaSb QDs:

Fiber-compatible on-demand quantum light sources

Best QDs: 900nm InGaAs and 780nm GaAs
– high transmission losses in fibers and air

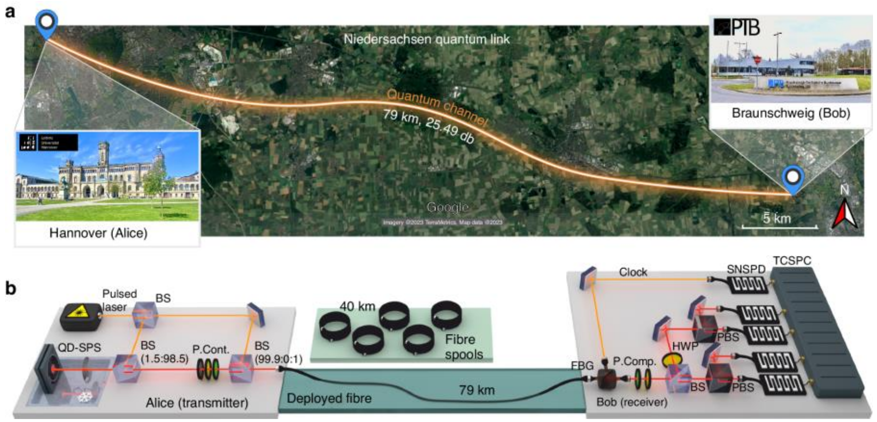


M. Zahidy et al. npj Quantum Information 10, 2 (2024).



F. B. Basset et al. Sci. Adv. 7, 6379 (2021)

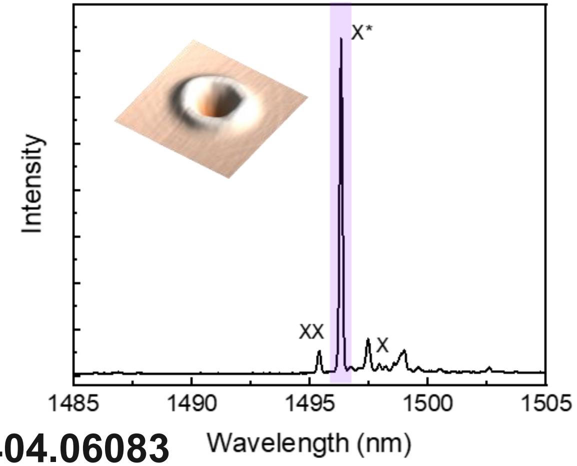
Fiber-compatible: 1550 nm InGaAs QDs
– current QKD SoA with 4.8×10^{-5} key bits/pulse



J. Yang et al. Light: Sci.& Appl. 13, 150 (2024)

Our Telecom GaSb QDs

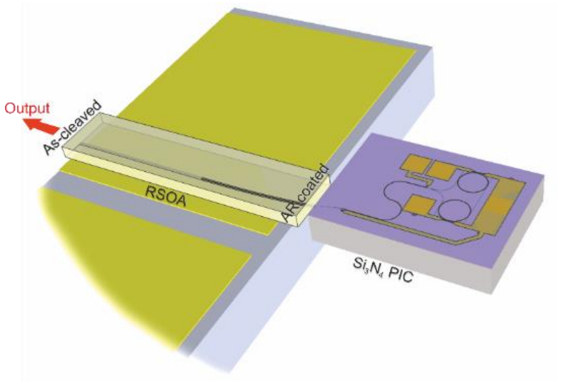
- ➢ Properties matching the best short wavelength QD materials
- ➢ But at fiber-compatible wavelength



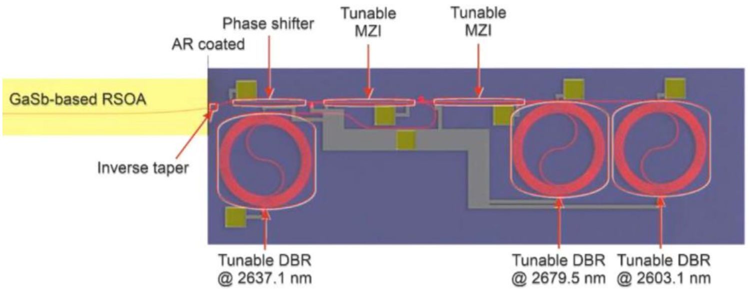
Teemu Hakkarainen: **https://arxiv.org/abs/2404.06083**

GaSb/PIC Hybrid Laser

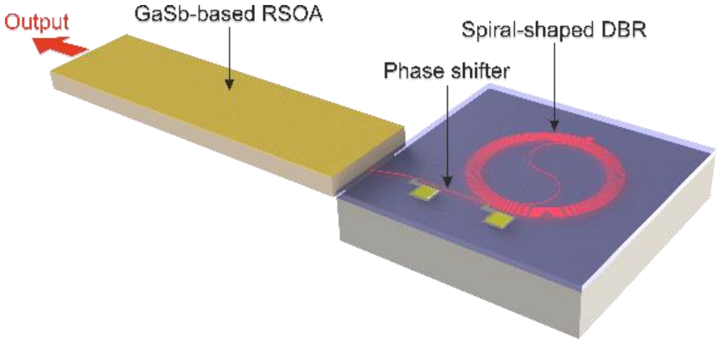
Widely tunable laser



Discretely tunable laser



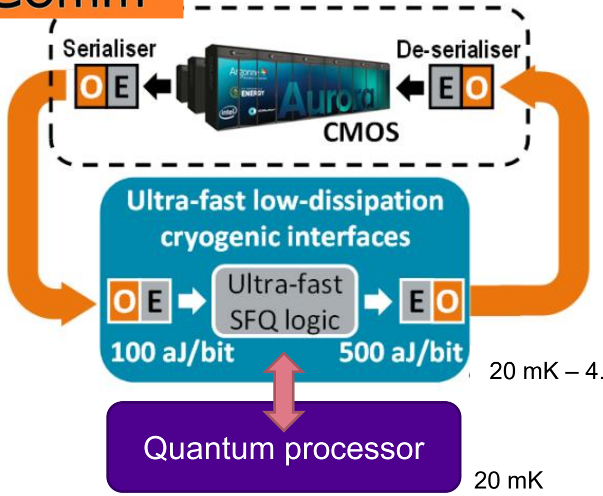
Narrow linewidth laser



Tampere University

New approaches for cryogenic optical links

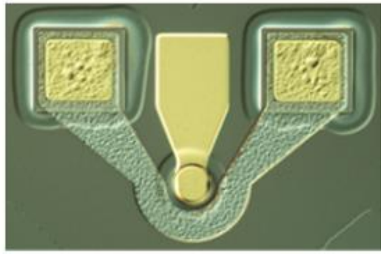
Interfacing quantum and classical computers

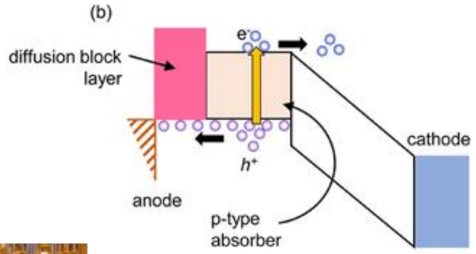


https://www.acrycomm.eu/

Optical-to-electrical conversion

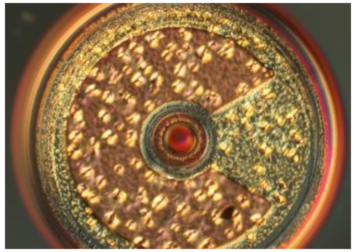
- Based on uni-traveling carrier photodiode (UTC-PD)
- Exploration of high electron mobility materials at 4.2 K
- **Target for 100 GHz @ 4.2 K**

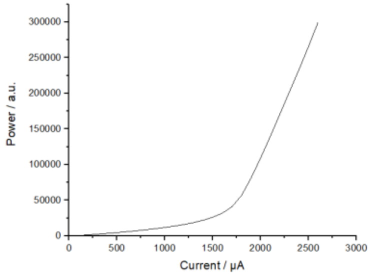


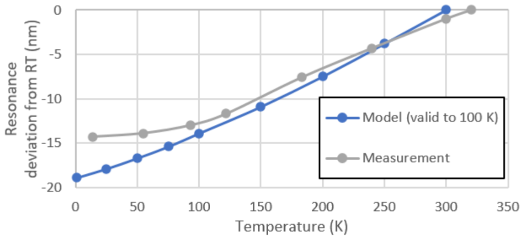


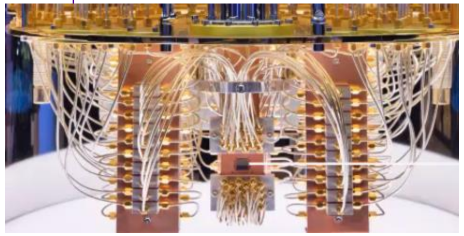
Electrical-to-optical conversion

- Based on cryogenic VCSEL
- Exploration of 4.2 K operation and miniaturization beyond SoA
- Proof-of-concept demonstrated (2022)









Senior Research Fellow
Dr. Teemu Hakkarainen

FutureChips

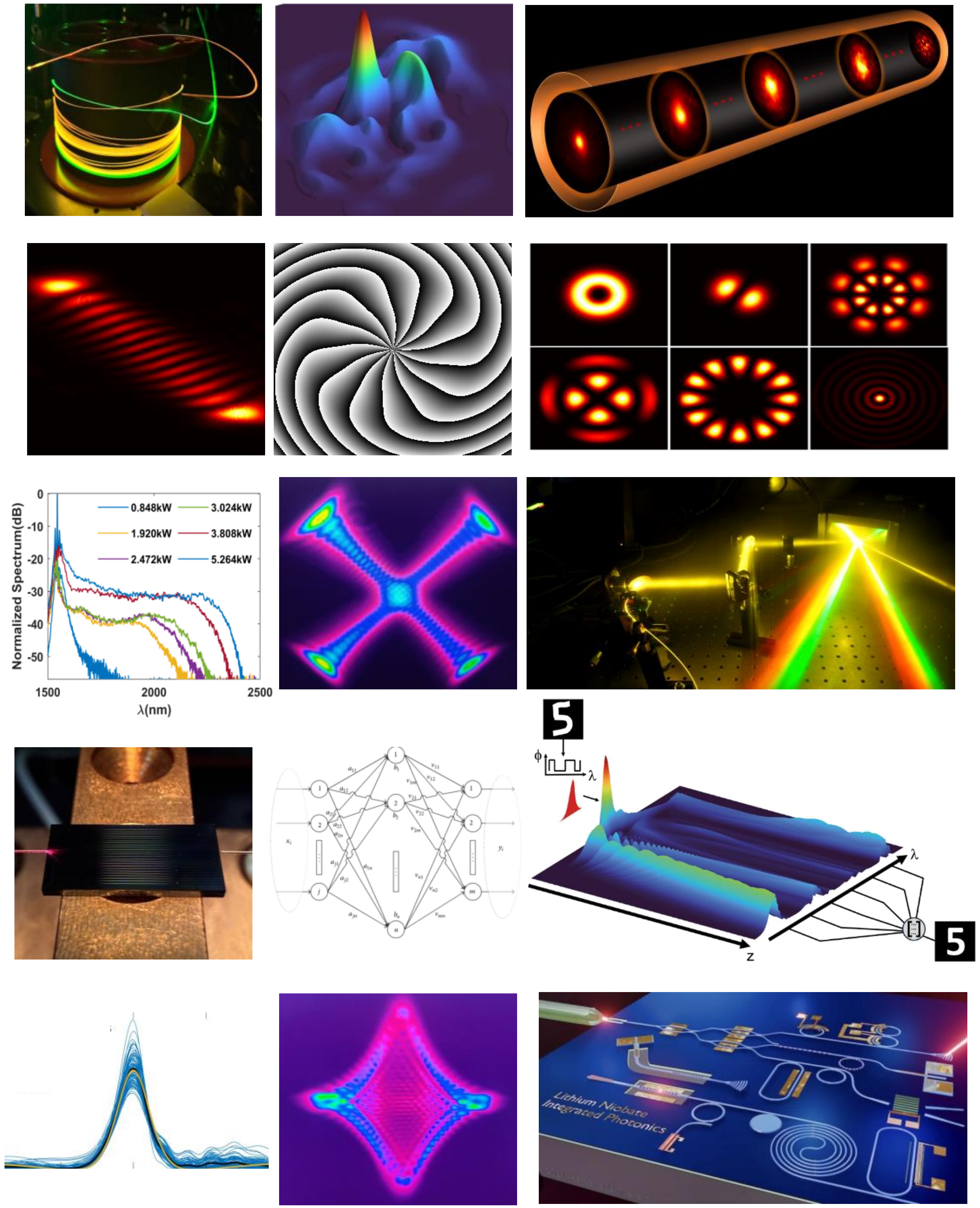
Ultrafast Photonics Group

Advanced compound materials and heterostructures

- Waveguided nonlinear light generation, wavelength conversion, structured light
- Ultrafast, complex-field diagnostics
- Machine-learning control & optical computing

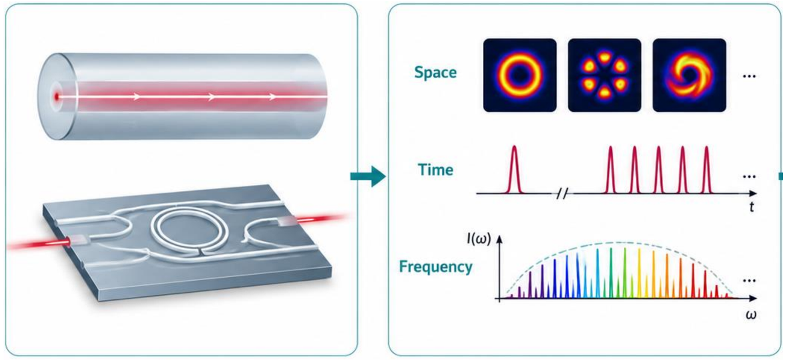
Optical fibers (single-mode, multimode, specialty fibers), from UV to mid-IR

Thin-film lithium tantalate chips



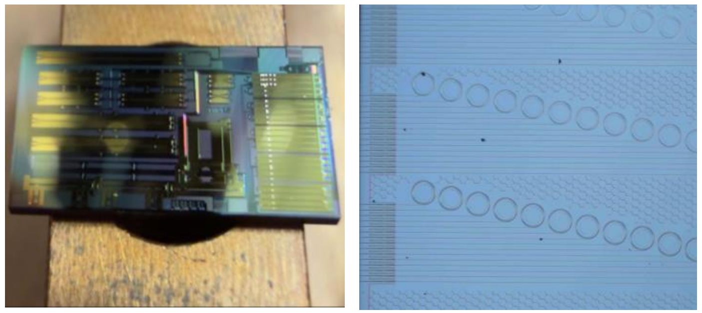
From physics-rich platforms to on-chip nonlinear functionalities

Physics-rich platforms



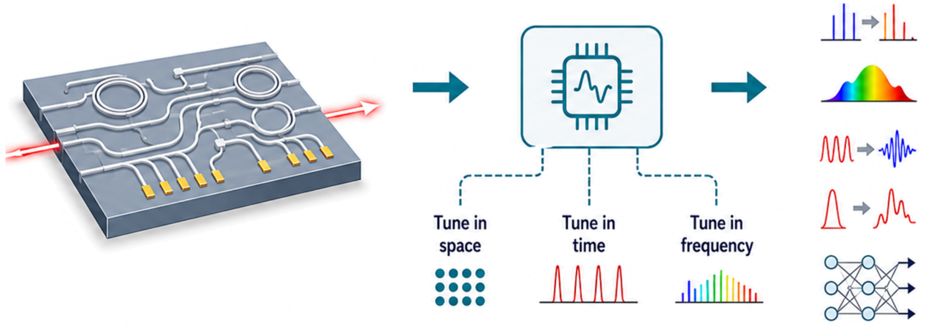
- Guided-wave systems (fibers, waveguides)
- Structuring light in space, time & frequency
- Multimode & nonlinear systems

Integrated nonlinear photonics



- Nonlinear functionality on chip-scale platforms
- TFLT, SiN, $LiNbO_3$, AlN

Programmable functionalities



- Frequency conversion, supercontinuum generation, parametric gain, modulation, pulse shaping, neuromorphic computing
- Flexible and reconfigurable platfroms

Use ultrafast nonlinear optics as an active layer for applications in sensing and chip-scale information processing

Enabling nonlinear optical functions on emerging chip platforms

Advanced experimental capabilities

- Ultrafast optical testing (CW, ns, ps and fs excitation; telecom, near-IR and visible wavelength ranges)
- Advanced temporal, spectral and spatial diagnostics (FROG, spectral interferometry, off-axis holography, OSA/camera-based measurements)
- Programmable optical excitation

(Spatial light modulators, electro-optic modulators, spectral waveshaping)

- Closed-loop optimization and machine-learning control

Chip / platform development routes

- TFLT and nonlinear photonic chips via clean-room / foundry collaborations
- Input on device specifications for nonlinear optical functions
- dispersion, phase matching, coupling, power handling
- Periodic poling and quasi-phase-matching concepts
- Experimental feedback loop between design, fabrication and optical testing

Know-how

- Nonlinear and ultrafast photonics
- Waveguide and integrated photonic device physics
- Numerical modelling of nonlinear propagation and device performance
- Machine-learning-assisted control, optimization and data analysis

What fellows get: a bridge between materials/device and experimentally validated nonlinear photonic functions

Possible research directions

The ultrafast photonics groups is an excellent match for fellows who want to connect materials, integrated photonics, and nonlinear ultrafast functionality

Examples where the group can host or co-supervise projects area:

01	**TFLT nonlinear building blocks**	Efficient wavelength conversion, supercontinuum generation, and pulse shaping on low-loss thin-film platforms
02	**Dielectric / TFLT interfaces**	Use heterostructure integration to combine gain, nonlinearity, guiding, and high-speed control
03	**Mid-IR photonic sources**	Chip-compatible nonlinear sources for integrated molecular sensing (mid-IR supercontinuum and frequency-comb, optical parametric sources etc.)
04	**Optical computing**	Physical nonlinear transformations as computing layers for reservoir / extreme-learning machine concepts (nonlinear waveguides, semiconductor optical amplifiers, microresonators, multimode photonic circuits, hybrid photonic-electronic readout etc.)
05	**Programmable photonic chips**	Closed-loop machine-learning control for nonlinear devices and photonic-electronic systems (modulators, filters, nonlinear waveguides, OPO/OPA sources, frequency-comb generators, photonic-electronic feedback circuits etc.)

Webiste: https://research.tuni.fi/ufo-en/

Contact: goery.genty@tuni.fi

CMOS AND BEYOND: DEVICES AND SYSTEMS RESEARCH GROUP

Fab Lead: Sozaraj Rasappa, Currently at SiPFab

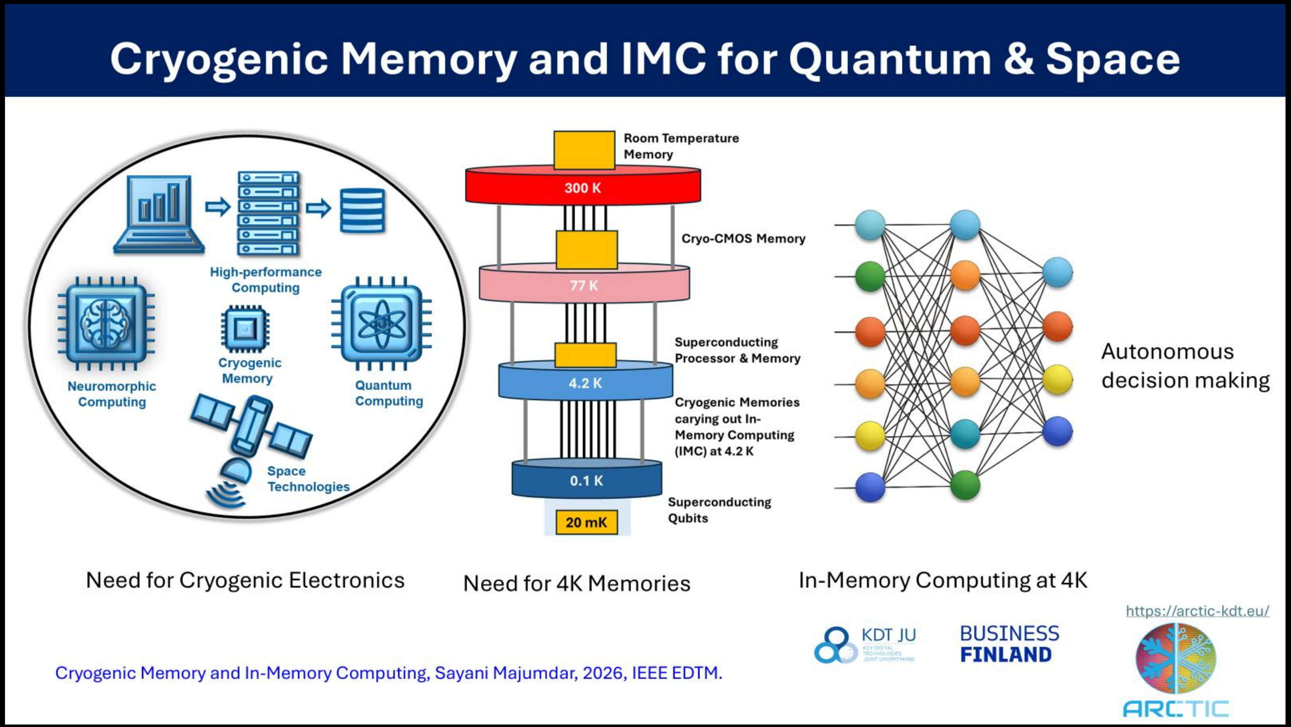
Group composition, Postdocs: 2, PhD Students: 6, Masters students: 2

Details of project portfolio: https://research.tuni.fi/cmos-and-beyond/

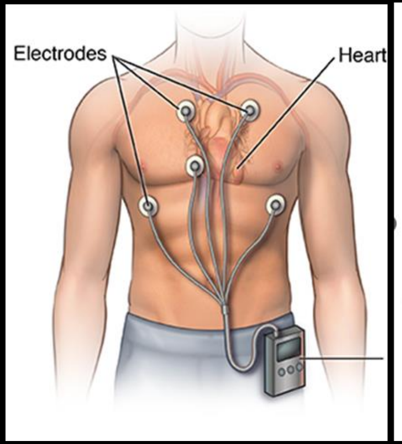
Tampere University

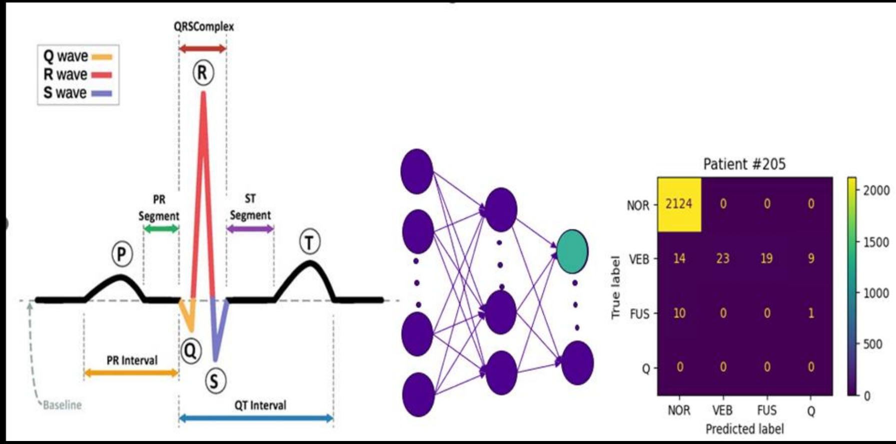
FUTURE COMPUTING HARDWARE – NEUROMORPHIC EDGE AI

- Memory, Sensing and Logic components and circuit development with special focus on Device and Systems-level *Performance Reliability*.
- AI-driven Materials and Process design for next generation of Computing Devices.
- Back-end compatible Low thermal Budget Ferroelectric and Semiconductors Device fabrication, Defect Characterization and Analysis, Physics-based Modelling, Yield and Reliability Analysis.
- Non-volatile Memories and In-Memory Computing operating down to deep cryogenic temperatures
- 3D integrated Sensor, Memory and Logic for Edge-AI HW
    - Health care (Arrythmia Detection using SNN)
    - Autonomous Vehicle (Multi-sensor fusion and decision making)



Low-power AI at the edge for health – Arrythmia detection in SNN





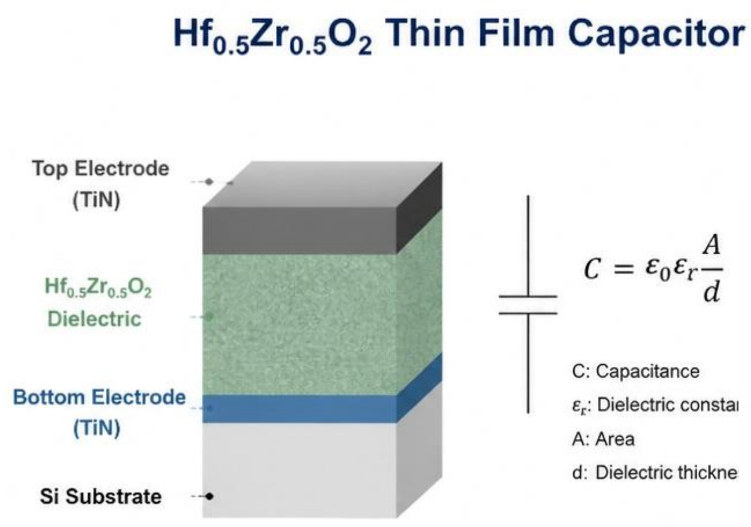
Sayani Majumdar, Assoc. Professor, sayani.majumdar@tuni.fi

Tampere University

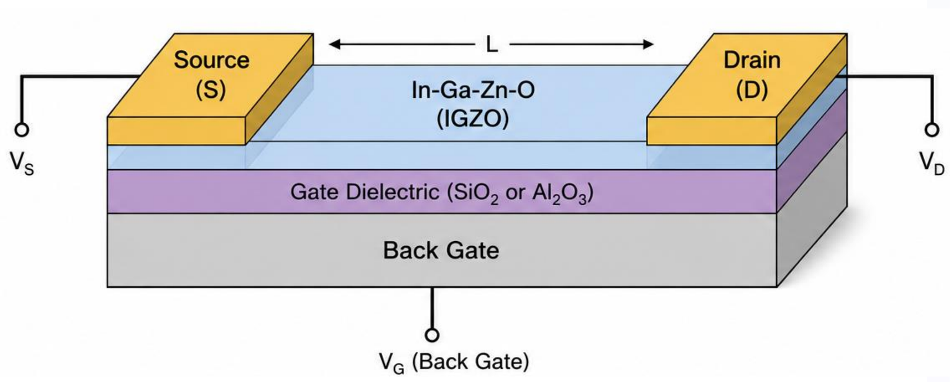
DEVICES FOR FUTURE COMPUTING HARDWARE

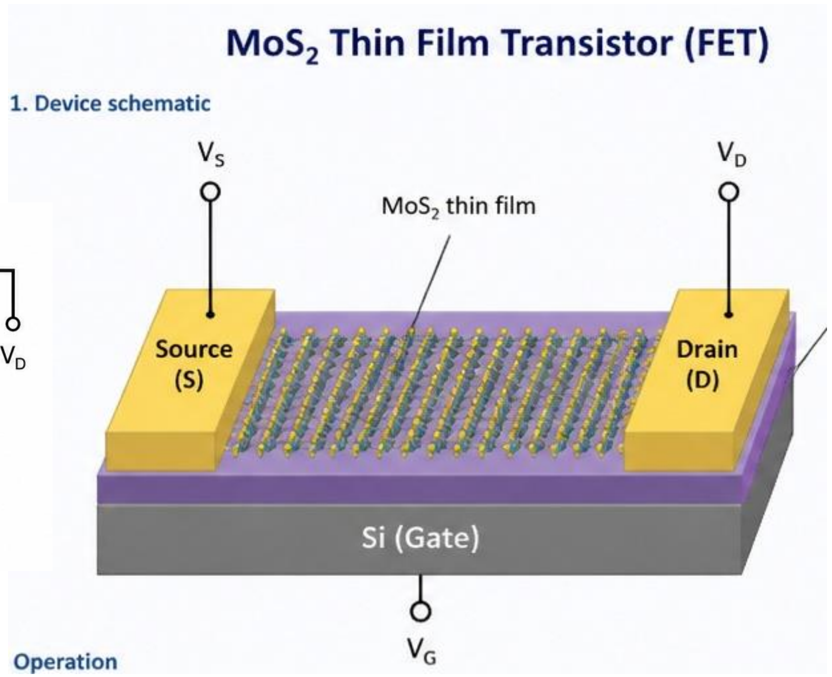
Sayani Majumdar, Assoc. Professor, sayani.majumdar@tuni.fi

Tampere University



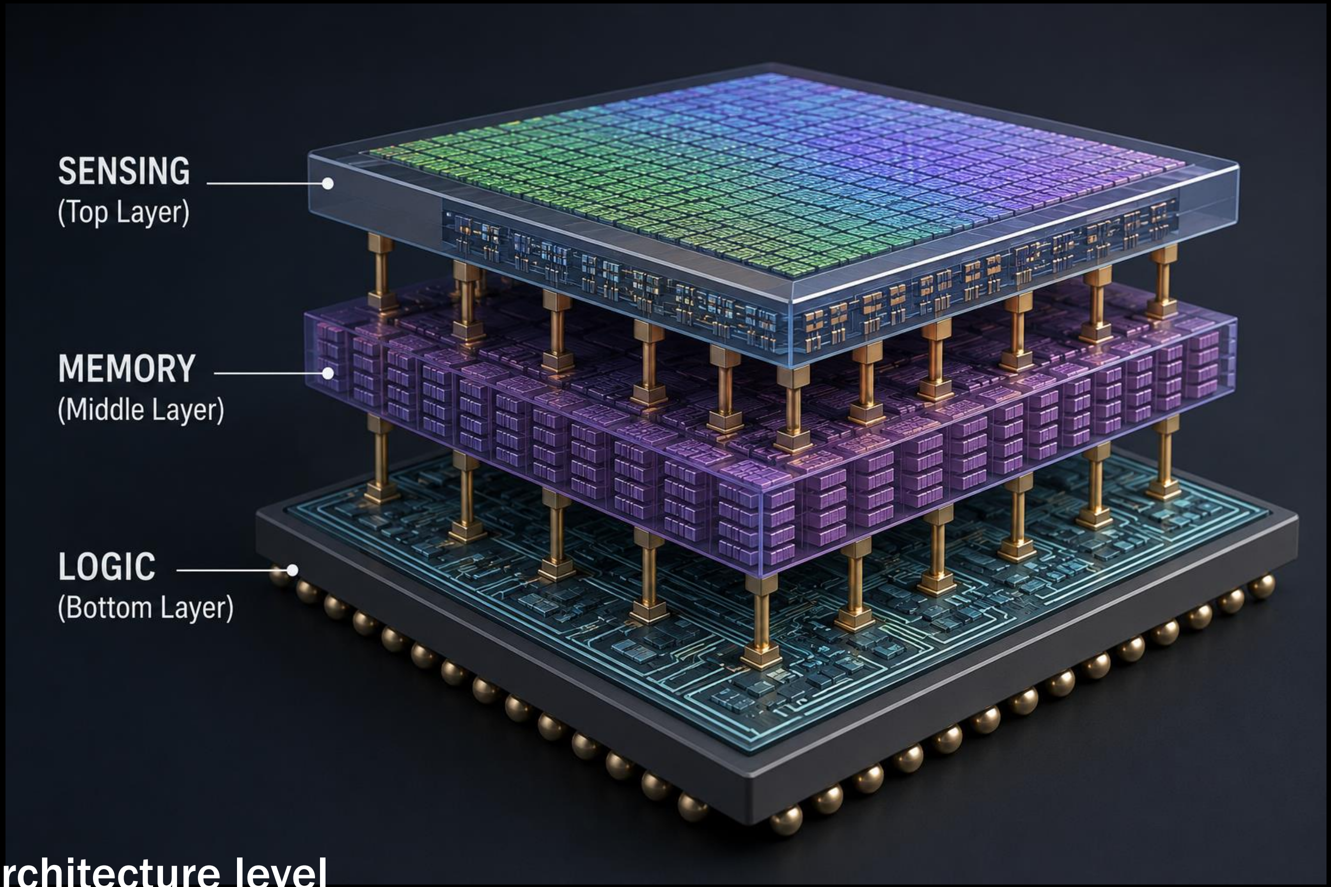
IGZO FeFET





DEVELOPMENT TARGETS: 1) LOW-POWER, 2) NANO-SCALE, 3) 3D-INTEGRATION FOR RESISTIVE AND CAPACITIVE IN-MEMORY COMPUTING 4) SELF-POWERED 5) HARDWARE SECURITY 6) NOVEL FUNCTIONALITIES

FULLY INTEGRATED FUTURE COMPUTING HARDWARE

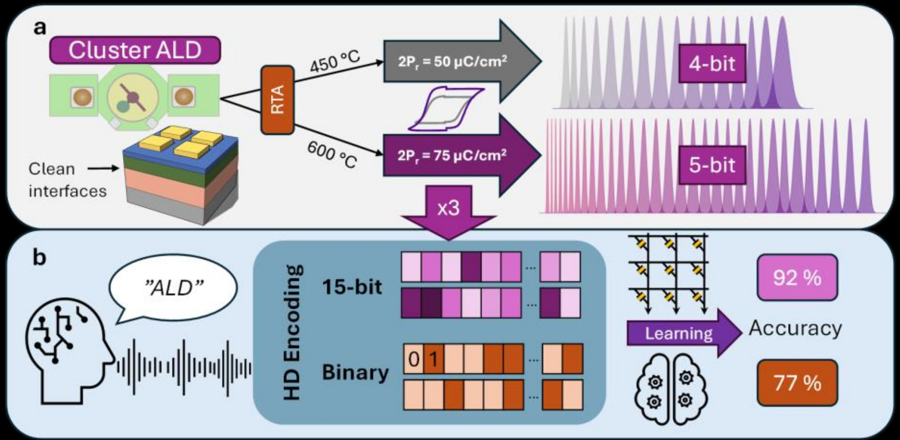


Innovation at both Device and Architecture level

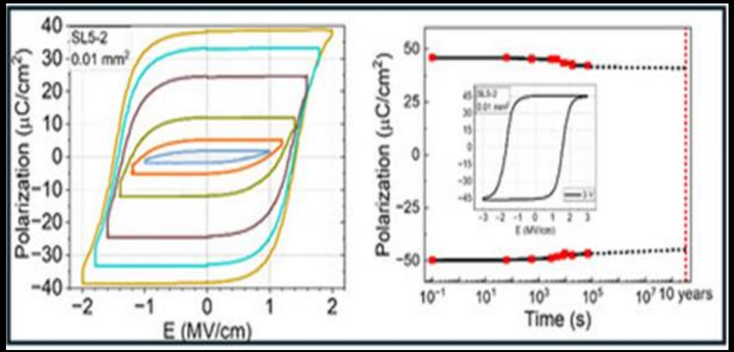
Sayani Majumdar, Assoc. Professor, sayani.majumdar@tuni.fi

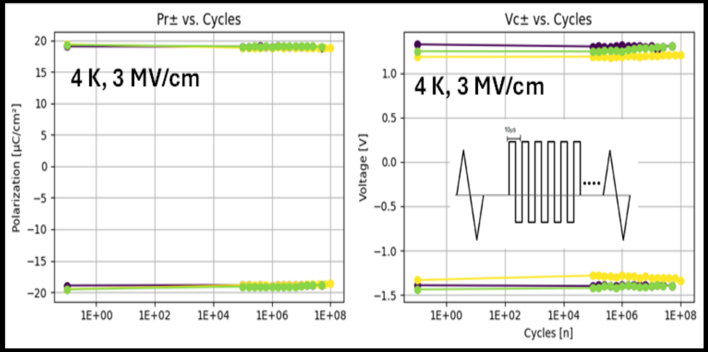
Tampere University

BEYOND STATE-OF-THE-ART RESULTS FOR FUTURE COMPUTING HARDWARE

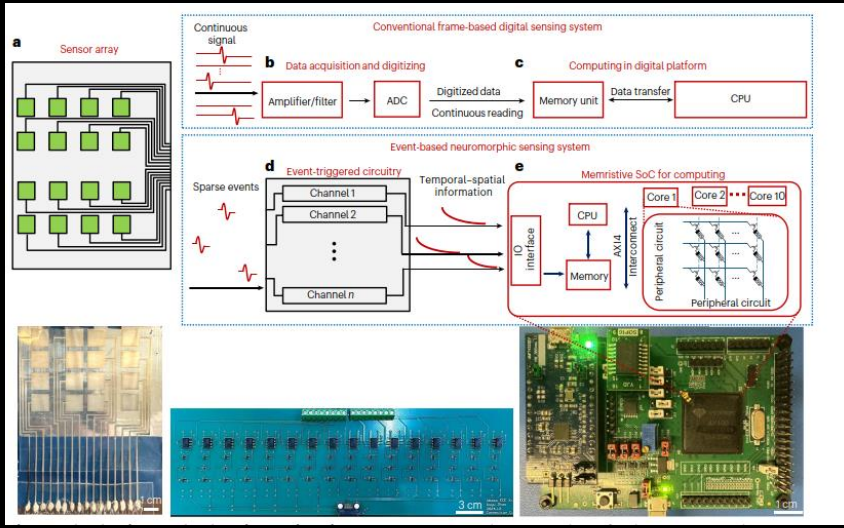


Capacitive IMC and HDC, Nature Microsys. and Nanoeng. (in press, 2026)

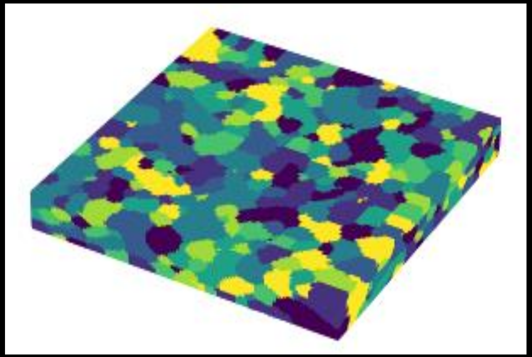




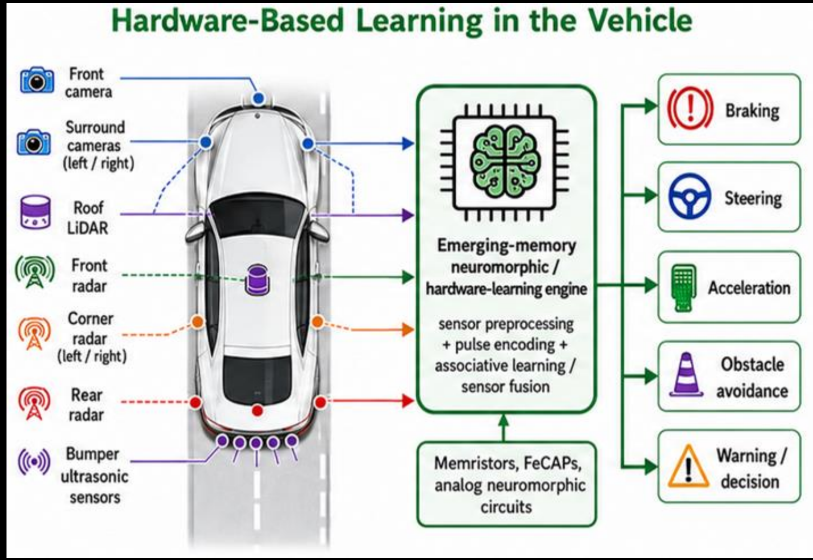
Low operating voltage NVM down to 4K, Adv Mater Tech, e02027, 2026



Near - sensor Computing, Nature Sensors 1, 163, 2026



Physics based compact model, Adv. Electron. Mater. 11, 2400840, 2025



Sensor Fusion and decision making at the Edge, Adv Intell Sys. 2025, Adv Electron Mater 2026, npj Unconventional Computing

Tampere University

Professor Matti Mäntysalo

Electronics, 0000-0002-7780-6454

Tampere University

Tampere Electronics Research Centre

System-on-Chip Hub

- Professor at the **Faculty of Information Technology and Communication Sciences** in the Electrical Engineering Unit, head of Electronics Research Centre
- **Research focus:** Redefining electronics materials, fabrication, and form factors to enable sustainable and scalable electronic systems
- **Expertise in:** Printed and additive electronics, thin-film devices, sensors, supercapacitors, and heterogeneous integration.
- **Collaboration offering:** From early concept and materials to integrated demonstrators and system-level validation, with emphasis on scalability and real-world deployment.

Keywords:
Printed and additive;
Flexible and stretchable;
Sustainable electronics;
Biobased and low-energy;
thin-film devices

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Page updated: 23.04.2026

Tampereen yliopisto

Prof. Mäntysalo’s research

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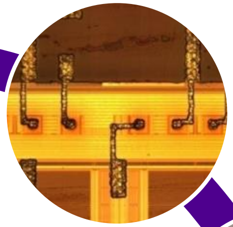
ORCID: 0000-0002-7780-6454
https://research.tuni.fi/lfe/

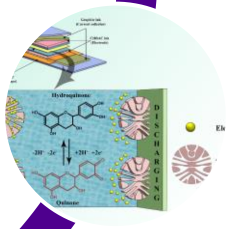
Focus and activities

Printed Electronics



Additive technologies and heterogenous integration

Flexible, conformable, stretchable electronics



Self-powered electronics

Thin-film devices and processes

FutureChips - related

Interconnections: replace wire-bonding, inkjet SiP, processing on wafers

Stretchable interconnections: geometry engineering, modeling and characterization

Transparent sensors: healthcare sensors

Supercapacitor: Electrode materials engineering; Non-toxic electrolyte

Energy harvesting: Piezo- and triboelectric nanogenerators; low-power circuits

Thin-film transistors on flexible and conformable substrates, diode, novel Atomic-Layer-Deposition processes

Tampereen yliopisto

Flexible and Printed Electronics

Heterogenous integration

JOURNAL OF THE
ELECTRON DEVICES SOCIETY

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Digital Object Identifier 10.1109/JEDS.2017.2764498

Electrical Contacts in SOI MEMS Using Aerosol Jet Printing

BEHNAM KHORRAMDEL[1], ALTTI TORKKELI[2], AND MATTI MÄNTYSALO[1]

1 Department of Electronics and Communications Engineering, Tampere University of Technology, 33720 Tampere, Finland
2 Murata Electronics Oy, 01621 Vantaa, Finland

CORRESPONDING AUTHOR: B. KHORRAMDEL (e-mail: behnam.khorramdel@tu

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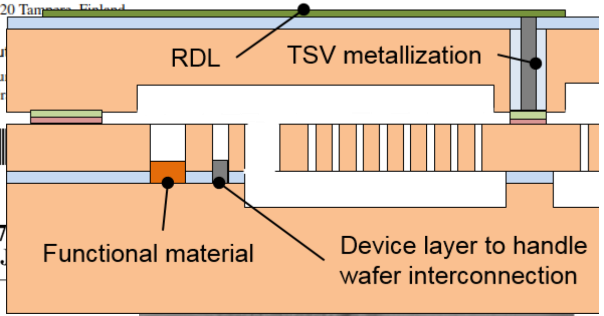
The work of M. Mäntysalo was supported by the Academy of Finland under Grant 288945 and Gr



US 20170166440A1

(19) United States
(12) Patent Application Publication
KUISMA et al.

(10) Pub. No.: US 2017
(43) Pub. Date:

(54) MICROELECTROMECHANICAL DEVICE AND METHOD FOR MANUFACTURING IT

(71) Applicant: MURATA MANUFACTURING CO., LTD., Nagaokakyo-shi (JP)

(72) Inventors: Heikki KUISMA, Helsinki (FI); Matti MÄNTYSALO, Lempäälä (FI)

(21) Appl. No.: 15/372,660

(22) Filed: Dec. 8, 2016

(30) Foreign Application Priority Data

Dec. 15, 2015 (FI) 20155948

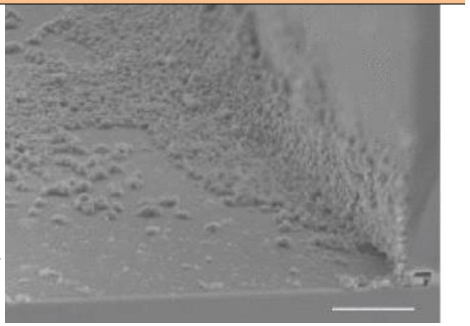
Publication Classification

(51) Int. Cl.
B81B 7/00 (2006.01)
B81C 1/00 (2006.01)

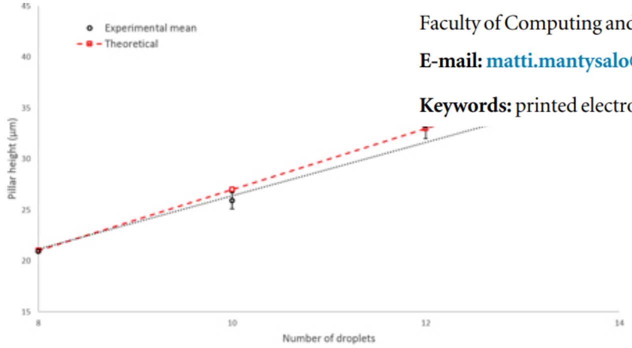
(52) U.S. Cl.
CPC *B81B 7/0006* (2013.01); *B81C 1/00373* (2013.01)

(57) ABSTRACT

A device and method utilizes interconnecting layers separated by an insulating layer. A layered structure comprises a first and a second layer of electrically conductive material, and a third layer of electrically insulating material between them. A via trench is fabricated that extends from the second layer through the third layer into the first layer, a surface on the first layer of electrically conductive material forming a bottom surface of the via trench. An ink-jetting set-up for a mixture of liquid carrier and nanoparticles of conductive material is formed, and a specific process period is determined. Capillary flow of nanoparticles to peripheral edges of an ink-jetted blob of said mixture is induced. The mixture is ink-jetted into a blob on the via trench; the layered structure is heated to evaporate the liquid carrier. The interconnection element is higher at a certain point than between opposing side walls.



http://DOI.org/10.1109/JEDS.2017.2764498



http://DOI.org/10.1088/2058-8585/aa9171

PAPER

Inkjet printed metallic micropillars for bare die flip-chip bonding

Behnam Khorramdel, Thomas M Kraft and Matti Mäntysalo

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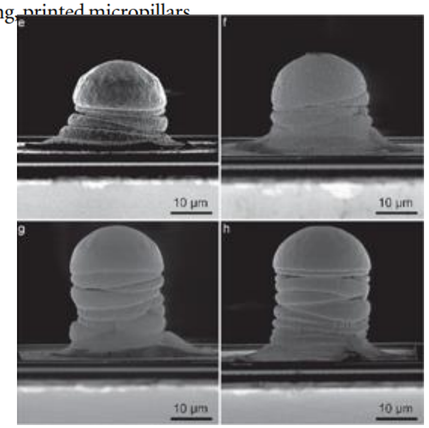
E-mail: matti.mantysalo@tut.fi

Keywords: printed electronics, inkjet, microelectronics packaging, 3D printing, printed micropillars



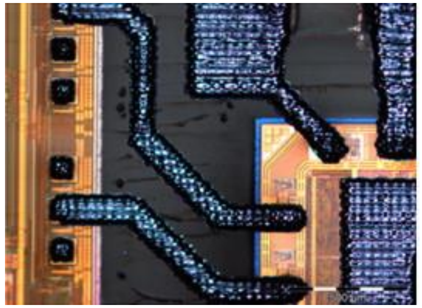
ELSEVIER

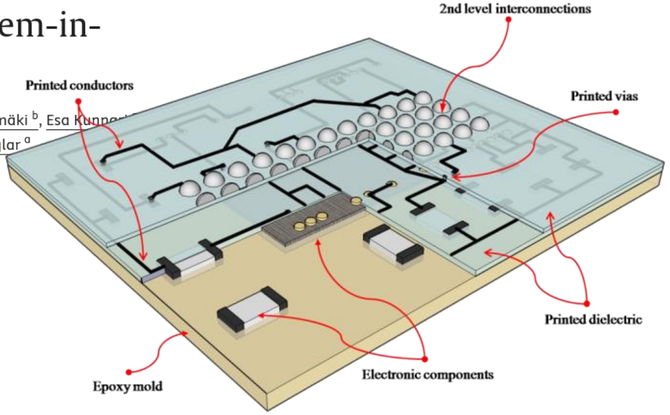
Microelectronic Engineering

Volume 87, Issue 11, November 2010, Pages 2382-2390

Utilizing inkjet printing to fabricate electrical interconnections in a system-in-package

Ville Pekkanen [a], Matti Mäntysalo [a], Kimmo Kaija [a], Pauliina Mansikkamäki [b], Esa Kunnari, Katja Laine [a], Juha Niittynen [a], Santtu Koskinen [a], Eerik Halonen [a], Umur Caglar [a]

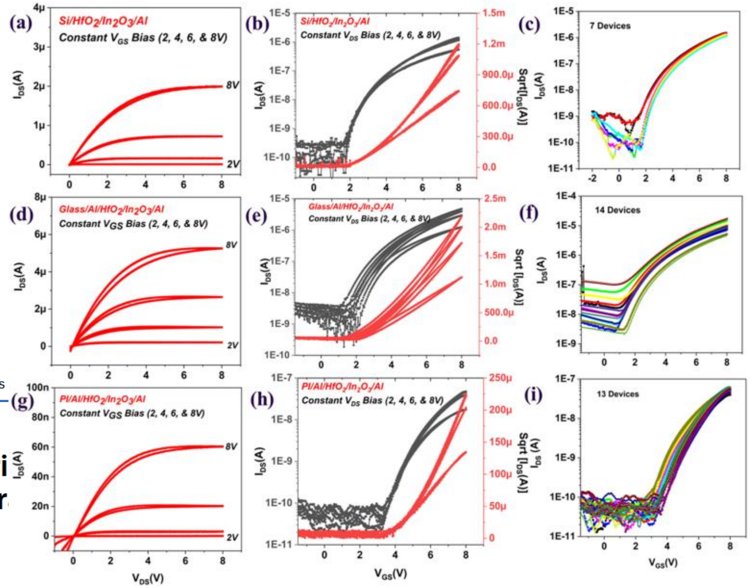




https://doi.org/10.1016/j.mee.2010.04.013

Tampereen yliopisto

Thin-film devices and processes



ACS APPLIED ELECTRONIC MATERIALS

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Direct PEALD Deposition of a HfO_2 Gate Dielectri... Passivation for TFTs on Rigid and Flexible Substr...

Amit Tewari,* Antti Tukiainen, Matti Mäntysalo, and Paul R. Berger*

https://doi.org/10.1021/acsaelm.5c00953

JOURNAL OF THE ELECTRON DEVICES SOCIETY

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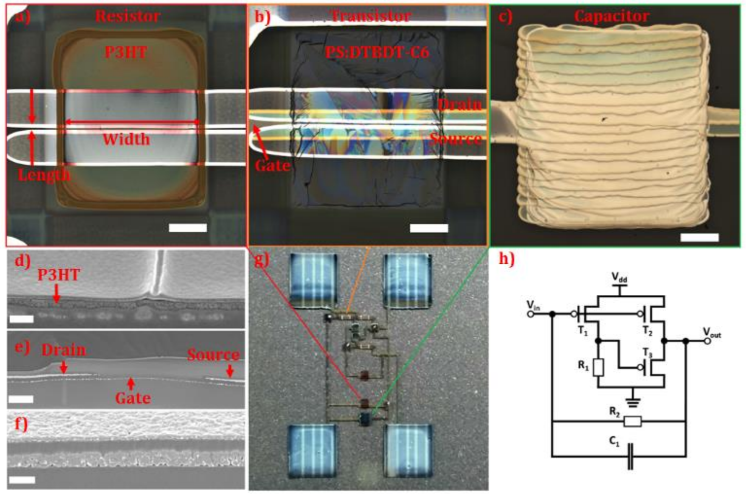
A Fully Printed Ultra-Thin Charge Amplifier for On-Skin Biosignal Measurements

MIKA-MATTI LAURILA[1], HIROYUKI MATSUI[2], REI SHIWAKU[2], MIKKO PELTOKANGAS[3], JARMO VERHO[3], KAREM LOZANO MONTERO[1], TOMOHITO SEKINE[2], ANTTI VEHKAOJA[3], NIKU OKSALA[3,4,5], SHIZUO TOKITO[2], AND MATTI MÄNTYSALO[1] (Member, IEEE)

https://doi.org/10.1109/JEDS.2019.2915028



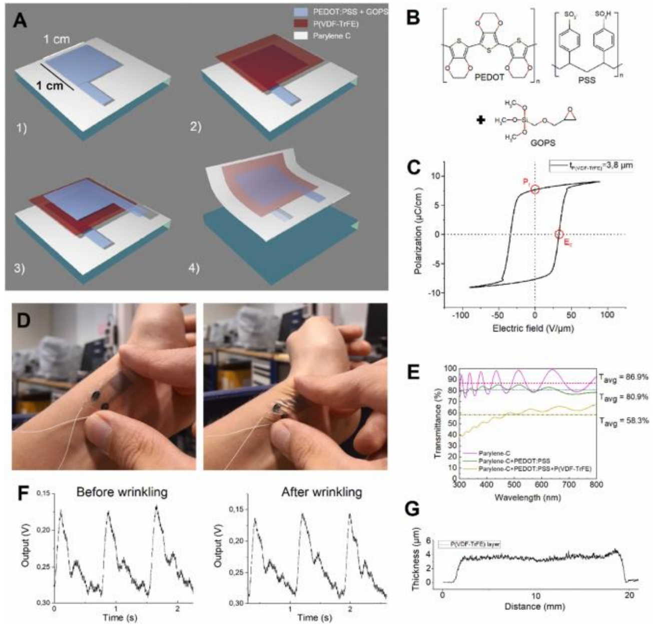
ELSEVIER

Nano Energy

Volume 102, November 2022, 107625

Self-powered, high sensitivity printed e-tattoo sensor for unobtrusive arterial pulse wave monitoring

Mika-Matti Laurila [a], Mikko Peltokangas [b c], Karem Lozano Montero [a], Jarmo Verho [b], Mira Haapala [b c], Niku Oksala [b c d], Antti Vehkaoja [b c], Matti Mäntysalo [a]



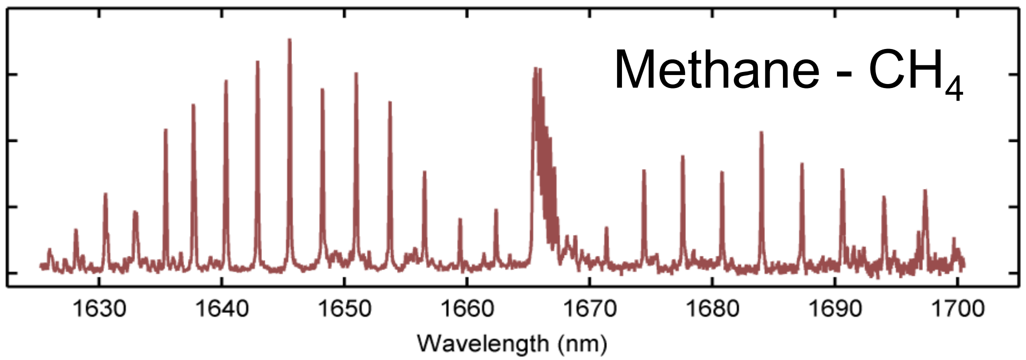
https://doi.org/10.1016/j.nanoen.2022.107625

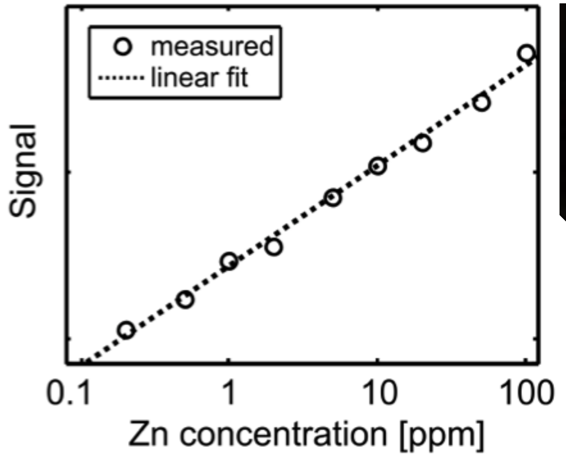
My offering

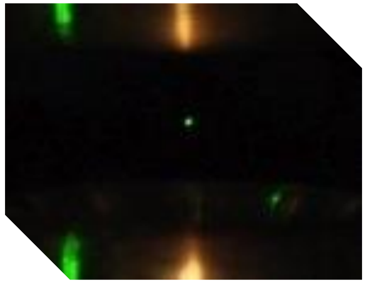
- Access to world-class infrastructure:
  - Our Lab (LFE) is a part of national Printed Intelligence Infrastructure (PII)
  - Infrastructure funding RCF FIRI 2019-2028
  - See details (https://research.tuni.fi/lfe/): PrintLab; Thin-Film fabrication
- Research:
  - **Additive technologies and heterogenous integration** enables new heterogeneous integration paradigms by combining diverse materials and technologies into compact 3D architectures with improved performance and lower cost
  - **Thin-film devices and circuitry** enabled by advanced ALD processes provide precise materials engineering and conformal nanoscale layer deposition, opening new opportunities for flexible electronics, emerging device architectures, and heterogeneous integration

Applied Optics research group
Prof. Juha Toivonen

- Gas sensing
  - Atmospheric gases: methane, acetylene, CO_2, NO, NO_2,…
  - Combustion gases: KCl, NaCl, KOH, $PbCl_2$,…
- Elemental analysis
  - Zinc content in water
  - Carbon content in soil
  - Bromium content in plastics
- LIDAR applications
  - Wind speed, humidity, temperature
  - Air polution $PM_{2.5}$, CO_2
- Optical imaging of radioactive sources
- Drinking water quality analytics with fluorescence

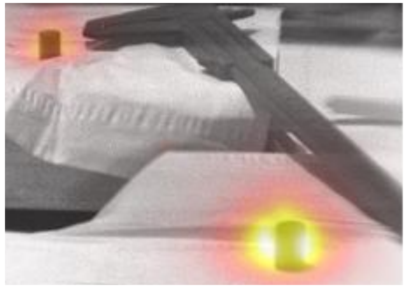






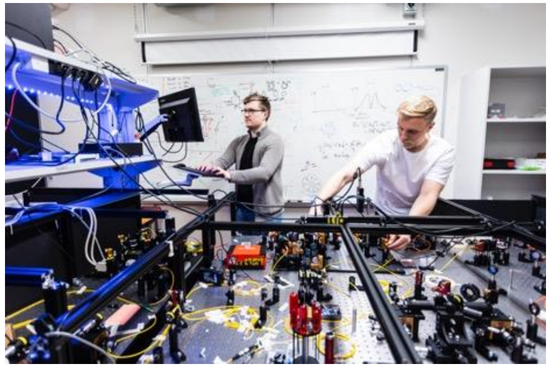
Patents

- granted 4
- pending 3



State-of-the-art Facilities


- Material growth and characterization
- Micro- and nanofabrication
- Measurement and testing
- Fiber-optics
- Coherent light sources
- Photonic integration
- Quantum optical technologies



Wire, die and flip-chip bonding, Microassembly

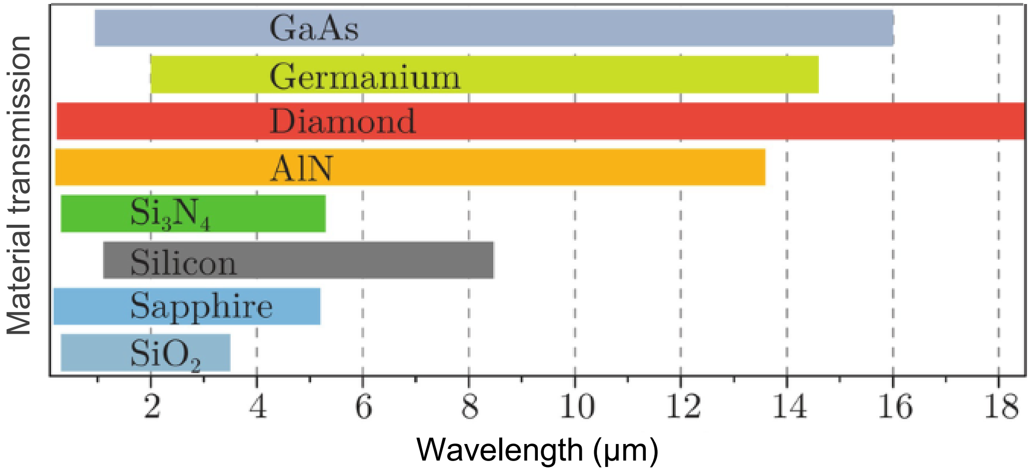
- ficonTEC BL2000 flip-chip bonder
- West Bond die bonder
- K&S Maxµm Ultra automatic wire bonder
- West Bond semi-automatic wire bonder
- LPKF ProtoFlow S solder oven
- ficonTEC CL1500 assembly system

The newest installation:

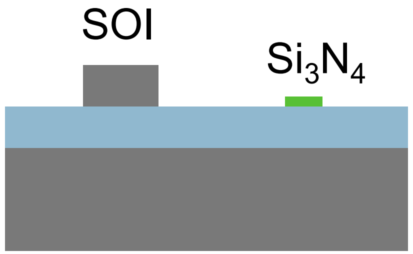
ACCURA Flip-Chip Bonder Plus

High Accuracy Automatic Flip-Chip Bonder

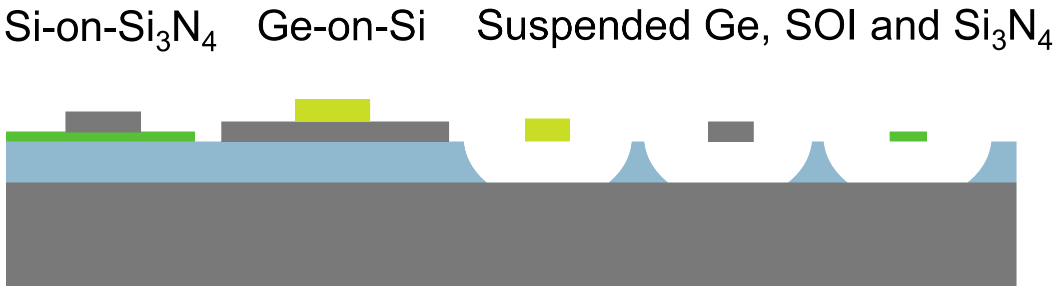
Sensing often requires Mid-IR wavelengths



Mature waveguide technologies



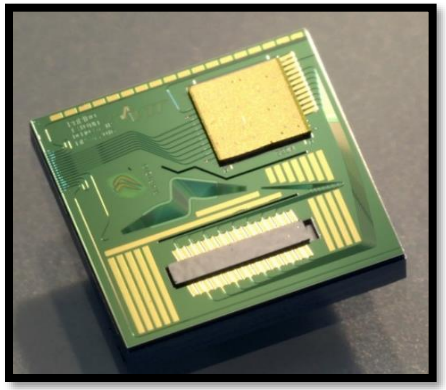
New Mid-IR waveguide technologies



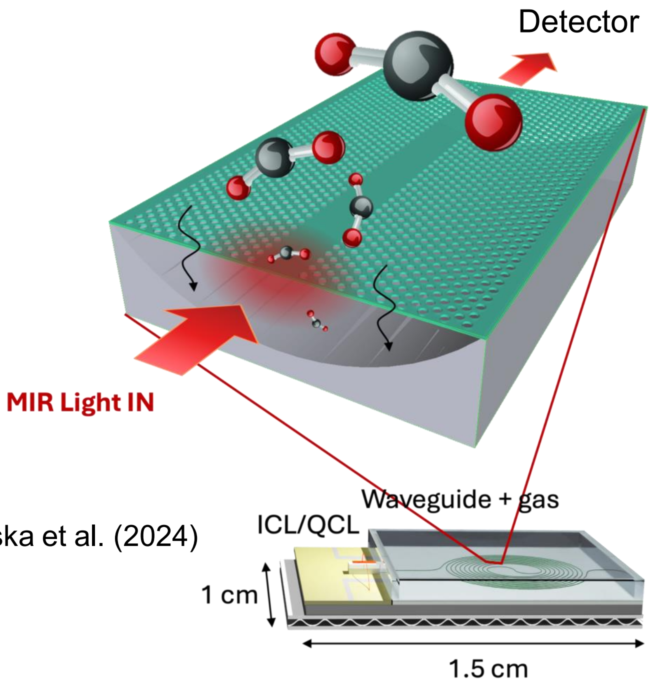
Tampere University

Potential project areas

Development of mid-IR waveguides and sensing methods

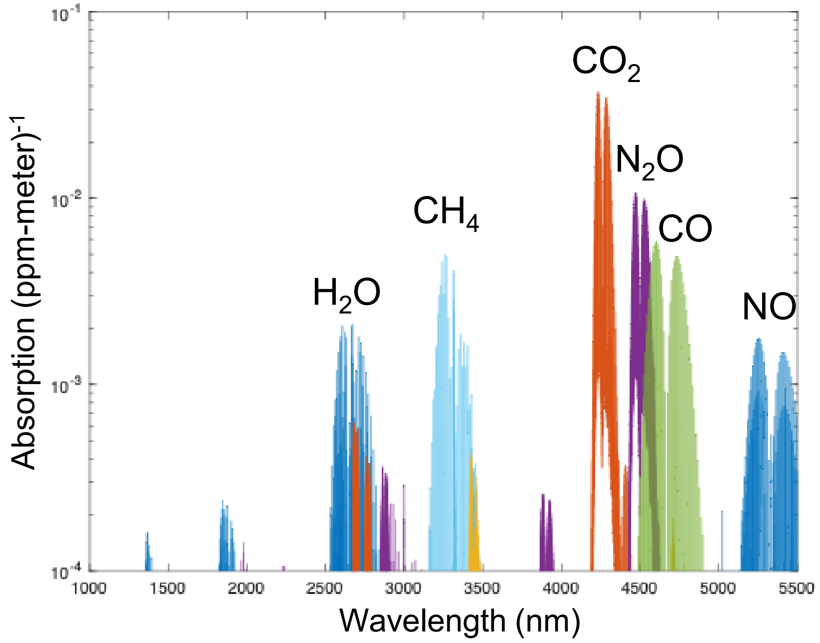


Development of the integrated platform for sensing including packaging



J. Jagerska et al. (2024)

Validation of the integrated sensing technology



Questions?

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