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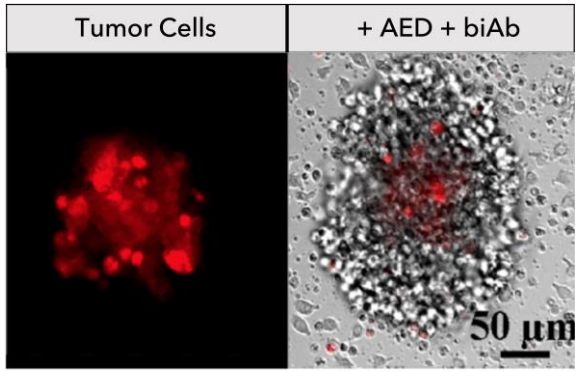
Tuesday, 28 March 2023

Spark Award

Top 20 inventions filed as patents in 2022



Enhancing cancer immunotherapy with engineered T cells

What's the technical challenge?

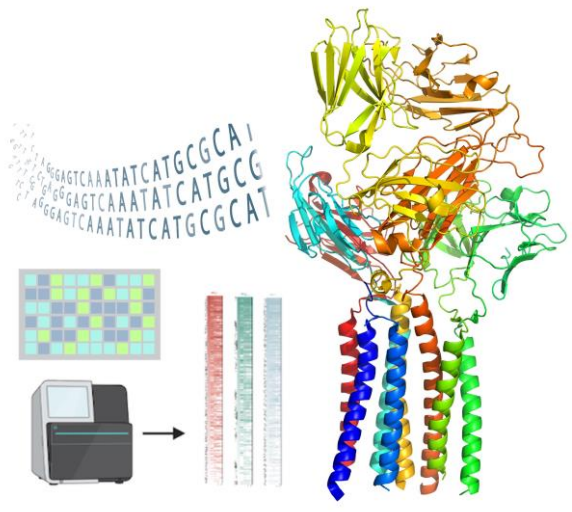
Non-engineered donor T cells are not safe for patients and can cause a life-threatening condition known as graftversus-host disease (GvHD).

What's the technical solution?

Allogeneic Engineered Decoupled (AED) T cells are safe of GvHD and effectively clear cancer cells when activated with a bispecific antibody.

What's the use?

AED technology can boost clinical efficacy of approved bispecific antibodies and 100+ molecules in clinical development.



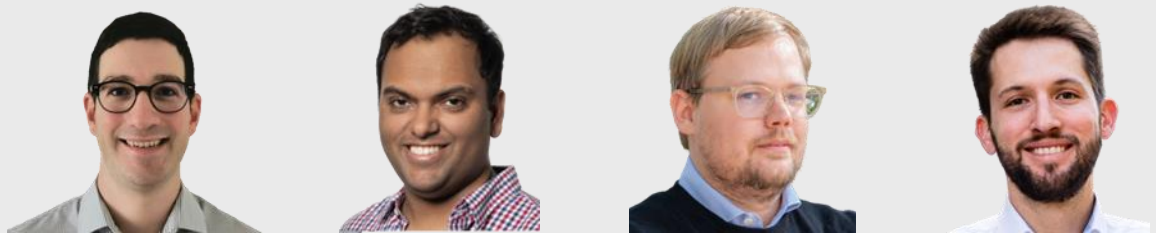
Laboratory of Systems and Synthetic Immunology (LSSI)

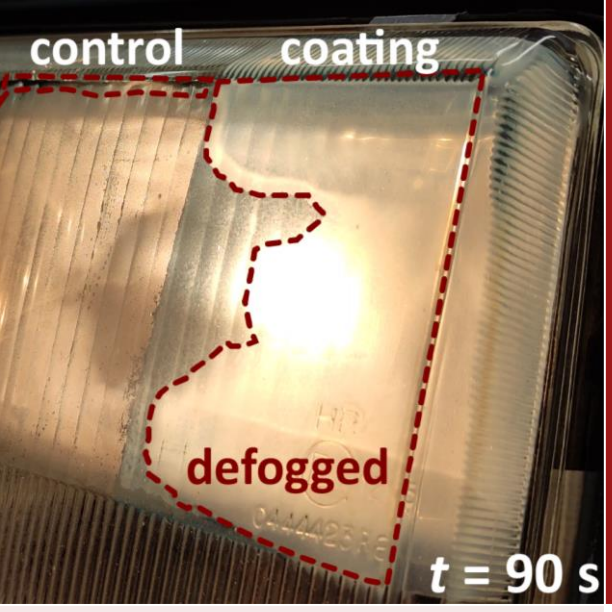
Dr. Edo Kapetanovic

Prof. Sai T. Reddy

Dr. Cédric R. Weber

Dr. Rodrigo Vazquez-Lombardi





A scalable, readily applicable photothermal coating for defogging in car headlamps

What's the technical challenge?

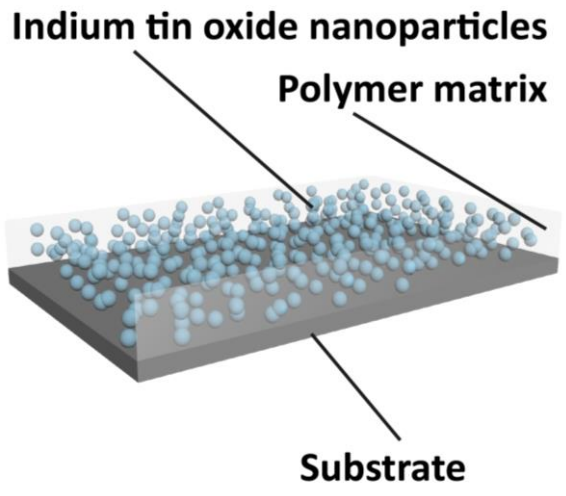
Foggy car headlamps detrimentally impair the driver's vision. Current energy-neutral approaches to mitigate fogging suffer from lack of robustness and hence require frequent maintenance or renewal.

What's the technical solution?

Our coating selectively absorbs the lightbulb's energy which is invisible to the human eye, heating up the headlamp and preventing fogging. The coating is transparent, maintenance-free, and readily scalable with industrial methods.

What's the use?

The coating reduces risks related to fogging in car headlights, increases road safety and avoids the replacement of foggy headlamps. This saves costs, resources and time.



Laboratory of Thermodynamics in Emerging Technologies (LTNT)

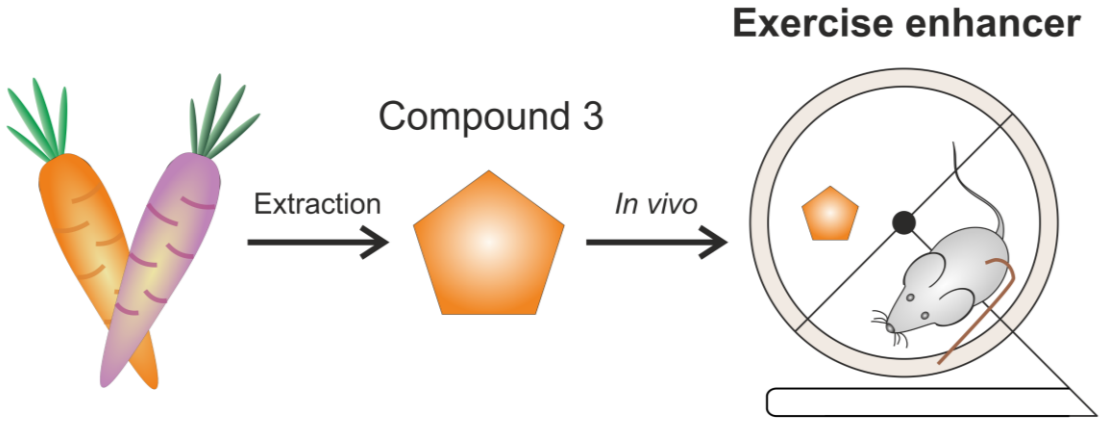
Dr. Iwan Haechler

Dr. Tamal Roy

Dr. Gabriel Schnoering

Prof. Dimos Poulikakos

A carrot-derived phytochemical to promote health, exercise capacity and lifespan



What's the technical challenge?

A rapidly aging population has led to an increasing prevalence of age-related ailments such as impaired physical fitness. Therefore, there is a high unmet need to develop novel treatment options.

What's the technical solution?

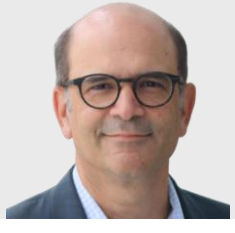
We characterized a novel anti-aging molecule as highly potent exercise enhancer and developed a synthesis and extraction protocol that enables large-scale procurement of this carrot-derived compound.

What's the use?

Supplementation with our compound has strong clinical potential to prevent frailty in the elderly by increasing physical endurance to support individual efforts to stay healthy.

Laboratory of Organic Chemistry (LOC)

Prof. Erick Carreira



Dr. Reto Erni

Laboratory of Energy Metabolism

Prof. Michael Ristow

Dr. Carolin Thomas

Instrument for simultaneous characterization of aerosol size and charge

What's the technical challenge?

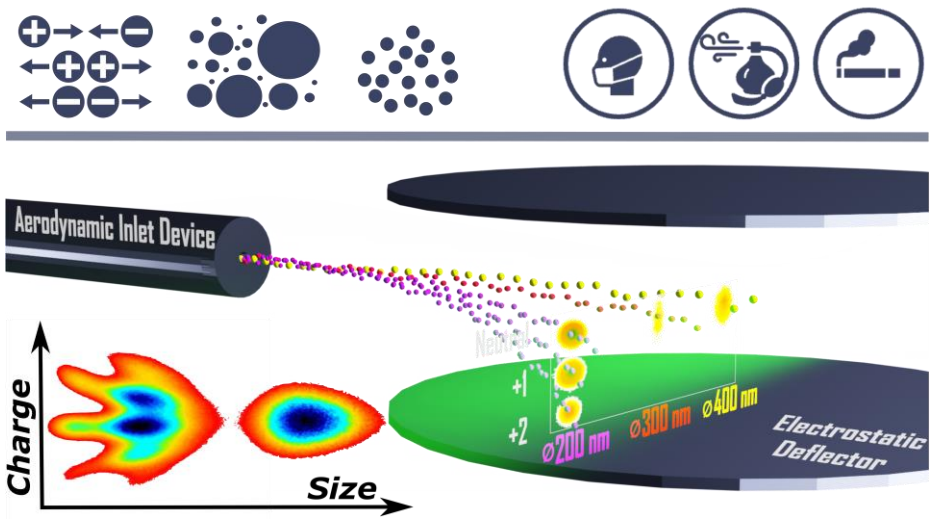
Size and charge or aerosol particles dictate their role for respiratory health and airborne disease transmission. There exist no simple, yet robust methods for their simultaneous characterization.

What's the technical solution?

Sampled aerosols form a particle beam that is deflected into a unique 2D pattern. Information on particle size and charge is contained in two independent axes and imaged by light scattering.

What's the use?

Instrument can be used for characterization of cough aerosols and filtration masks, as well as development of better medical nebulizers, e-cigarettes and heated tobacco products.



Aerosols and Nanoscience Group,
Prof. Ruth Signorell

Dr.
Loren Ban

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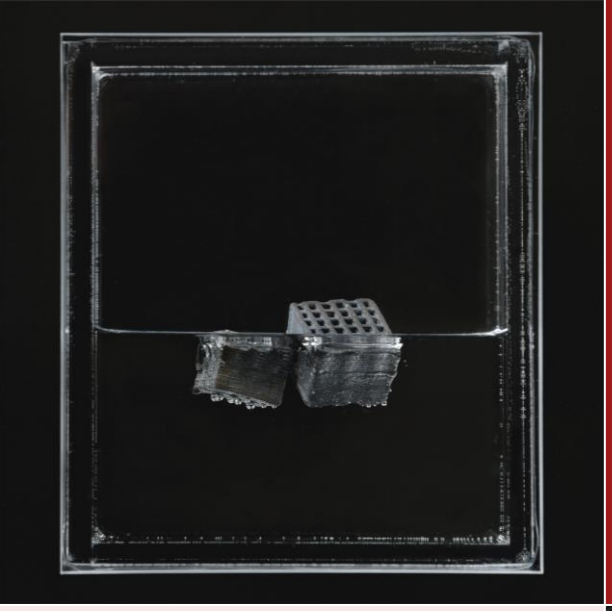


Swimming Steel

What's the technical challenge?

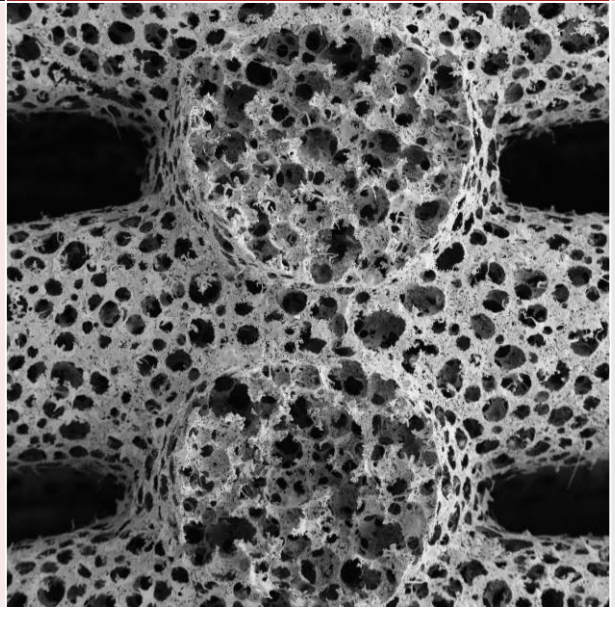
Current metal foaming processes are costly, cannot maximize surface area and porosity simultaneously, and introduce a large number of contaminants.

What's the technical solution?

Our particle-based metal foaming method results in novel microstructures that combine large porosity with an ultra-large surface area – and it is cheap!

What's the use?

The novel metal foams show promise as heat sinks, catalyst substrates, and even battery electrodes – any application that needs a large surface area and high thermal or electrical conductivity.



Complex Materials Group

Dr. Julia A. Carpenter

Neri Passaleva

Prof. André R. Studart

Spinning spheres for highly-sensitive NMR

What's the technical challenge?

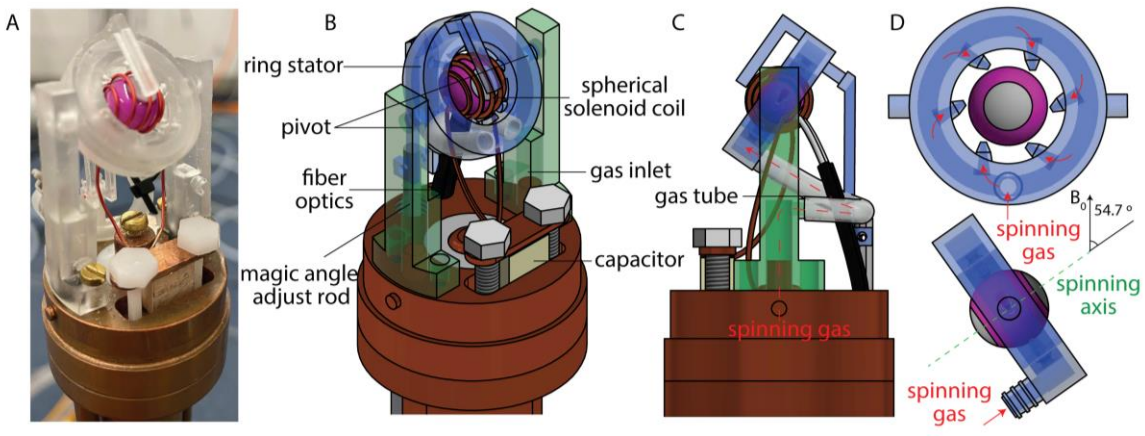
NMR sensitivity is relatively low compared to other analytical instruments. In addition, NMR containers are easy to crash when spinning at high spinning frequency to achieve better NMR sensitivity.

What's the technical solution?

Spherical NMR containers are the solution. Compared to the traditional cylindrical container, the spherical ones could bring higher NMR sensitivity and is more robust.

What's the use?

The traditional cylindrical containers in the NMR probehead can be replaced by the spherical ones to achieve higher NMR sensitivity. The spherical geometry makes the container more resistant to crush at high spinning frequencies.

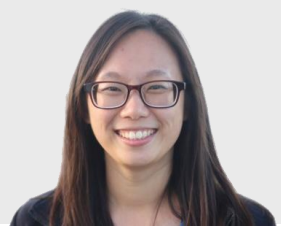


The Barnes Laboratory

Prof. Alexander Barnes

Dr. Chukun Gao

Dr. Pin-Hui Chen



Selective fluorescent molecular sensing of carbon dioxide

What's the technical challenge?

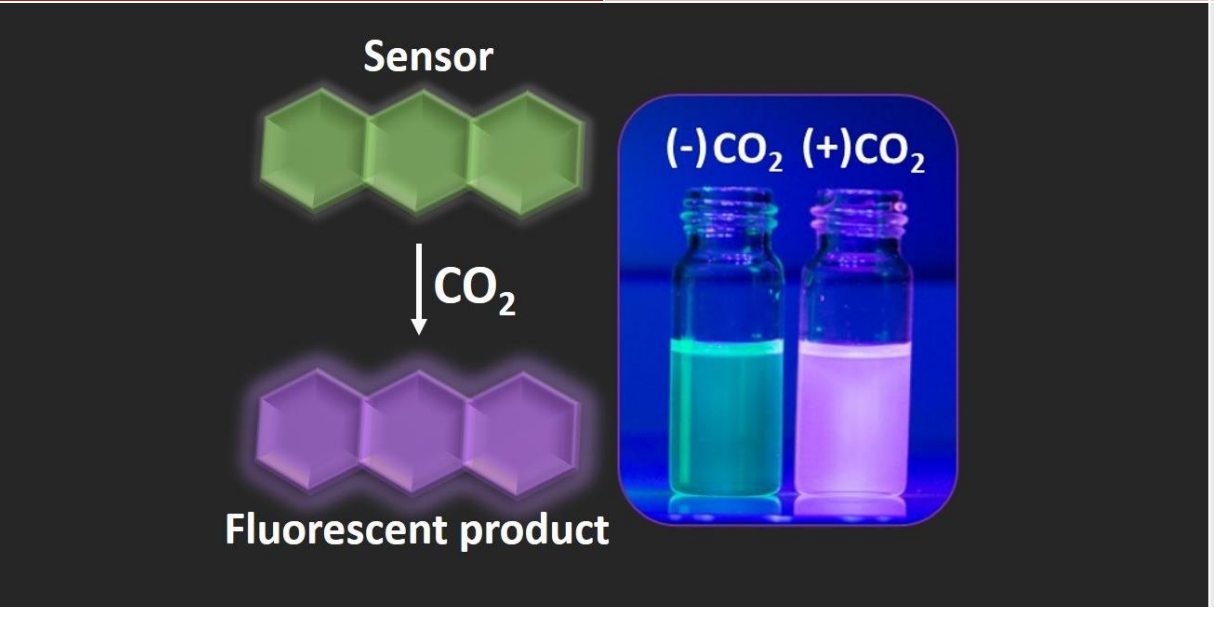
Chemical tools for selectively sensing CO_2 in biological systems are required to understand the physiological roles and functions governed by this gas molecule.

What's the technical solution?

The sensing mechanism in this invention is based on a molecular design that reacts selectively with CO_2 to generate a fluorescent product. This technology is compatible with organic and biological systems.

What's the use?

The invented technology is useful for sensing CO_2 in gas mixtures, monitoring enzymatic activity in inhibition assays, and imaging CO_2 in living cells.



The Morandi Lab

The QCSEL - the mid-infrared equivalent of the VCSEL

What's the technical challenge?

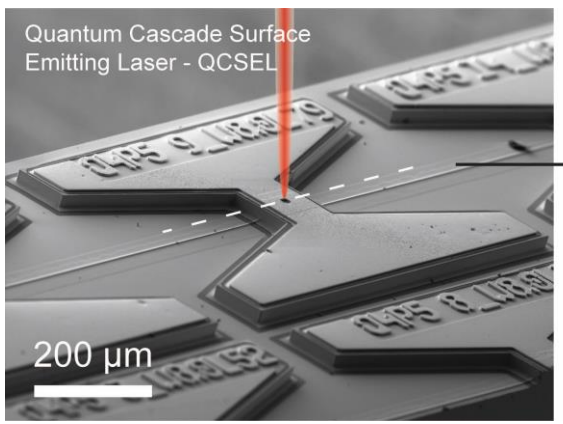
Current mid-infrared laser sources, ideally suited for gas sensing applications, are too costly and too bulky. Miniaturized and surface emitting lasers consuming low electrical power are desired.

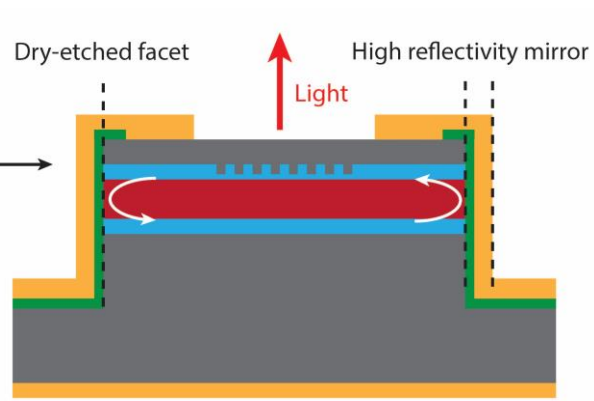
What's the technical solution?

We invented a surface emitting cascade laser, which can be produced in large scales at low cost. Wafer-level high reflectivity mirrors enable the miniaturization and the geometry defines the color of the single mode emission.

What's the use?

This new device will be an enabling technology for new generation low-cost, portable sensors for applications involving chemical sensing ranging from environmental monitoring, industrial process control to medical diagnostics.





Quantum Optoelectronics Group

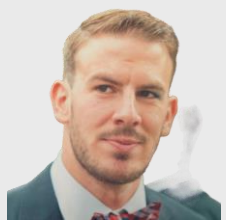
Prof. Jérôme Faist

David Stark

Dr. Zhixin Wang

Dr. Filippos Kapsalidis

Dr. Ruijun Wang



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An ultra-mobile ten-finger keyboard for the metaverse - anywhere, anytime

What's the technical challenge?

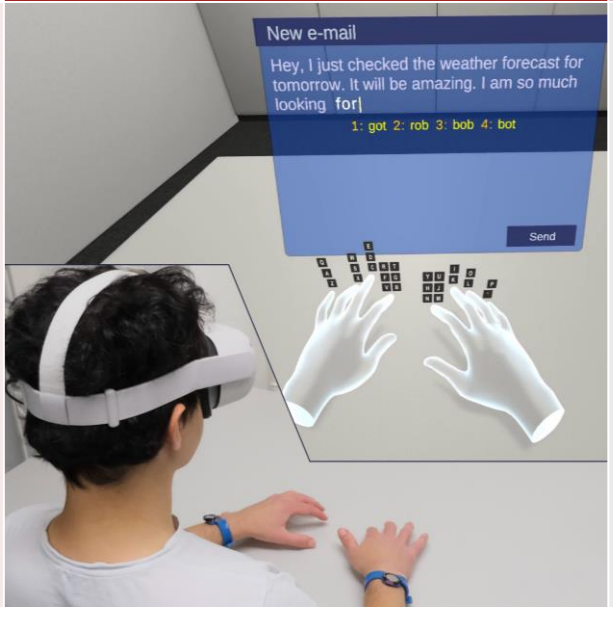
Mid-air VR typing lacks precise control and leads to fatigue that prohibits sustained productivity. Full-size text entry on surfaces solves this, yet touch sensing with wearable sensors is challenging.

What's the technical solution?

Our probabilistic decoding method takes the micro-vibrations of surface taps captured by accelerometer sensors inside portable and wireless wristbands as input to estimate the text from finger typing.

What's the use?

Wearable full-size typing on everyday surfaces anywhere. This enables opportunistic text input for mobile AR and VR applications, unlocking the key productivity task for the office of the future.



SIPLAB (Sensing, Interaction & Perception Lab)

Dr. Andreas Fender

Prof. Christian Holz

Jiaxi Jiang

Manuel Meier

Paul Streli

Peptide binder to ubiquitin ligase adapter FBXO31

What's the technical challenge?

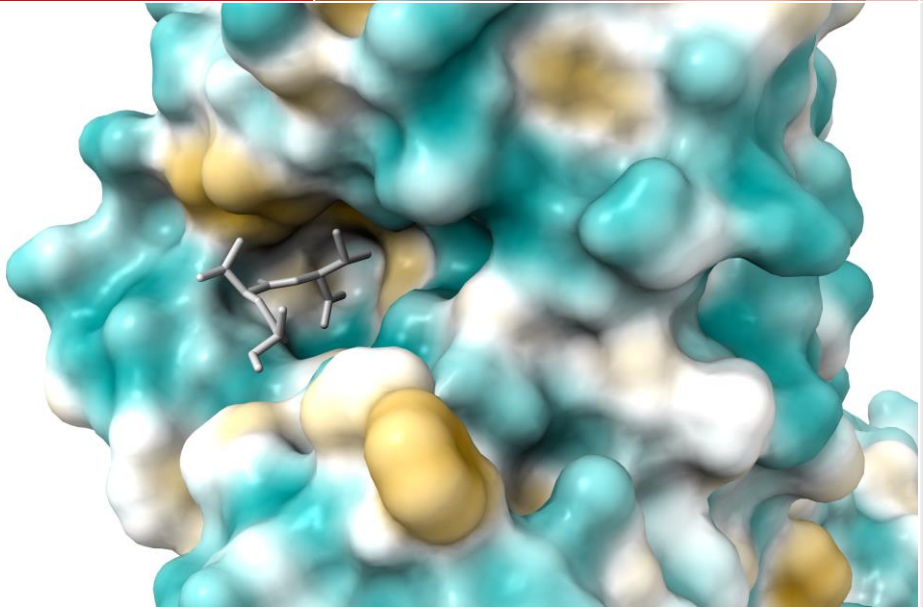
Disease-causing proteins can be removed from cells by drugs that bring them into contact with a compatible ubiquitin ligase. So far, clinical-grade ligands for only few ubiquitin ligases exist, leaving many proteins undruggable.

What's the technical solution?

FBXO31 is a ubiquitin ligase that is not specific to individual proteins, but binds to virtually any target that carries a C-terminal amide. Ligands that mimic this modification, could expand the target space of degrader drugs.

What's the use?

FBXO31-based degraders could be used to drug so-far undruggable proteins in a cell. They could also be used to overcome resistance to degrader drugs that are currently in use for cancer treatment.



Bode Research Group

The Corn Lab

Prof. Jeffrey Bode

Prof. Jacob Corn

Dr. Jakob Farnung

Dr. Raphael Hofmann

Dr. Matthias Muhar

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Combating fogging with transparent, sunlight-selective nano-absorbers

What's the technical challenge?

The recent pandemic showed how bothersome the loss of visibility can be. Current approaches to prevent fogging (hydrophilic sprays or towels) only work temporarily and require repeated application.

What's the technical solution?

Our coating is 1000 times thinner than a human hair, yet it harvests 30% of the sunlight through selective near-infrared absorption, where half of the solar energy resides. The strong localized heating significantly reduces fogging.

What's the use?

Due to its industrialized fabrication method, the transparent coating offers a cost-effective, scalable, durable, integratabale and sustainable approach to prevent fog on eyewear, mirrors and sensors, solely based on sunlight.

Laboratory of Thermodynamics in Emerging Technologies (LTNT)

Dr. Iwan Haechler

Dr. Gabriel Schnoering

Dr. Efstratios Mitridis

Prof. Thomas Schutzius

Prof. Dimos Poulikakos

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All-textile wireless motion sensing for the next generation of smart clothing

What's the technical challenge?

Motion tracking provides an avenue to monitor fitness and health status. Current wearable devices for human motion tracking are obtrusive for daily use as they employ rigid electronics and batteries on the clothing.

What's the technical solution?

Our smart clothing employs a yarn-based sensor with high sensitivity and a wireless readout featuring no rigid electronics on the garment. This solution allows free movement as it is seamlessly integrated into everyday clothing.

What's the use?

Smart clothing with movement tracking capabilities will allow access to information throughout daily life that is otherwise not available. Movement monitoring can be employed to reduce the risk of injury and improve physical performance.

Biomedical and Mobile Health Technology Lab

Dr. Chakaveh Ahmadizadeh
Dr. Tyler John Cuthbert
Valeria Galli
Prof. Carlo Menon
Pierre Roberjot





Recyclable anticorrosion coating for metals with self-healing properties

What's the technical challenge?

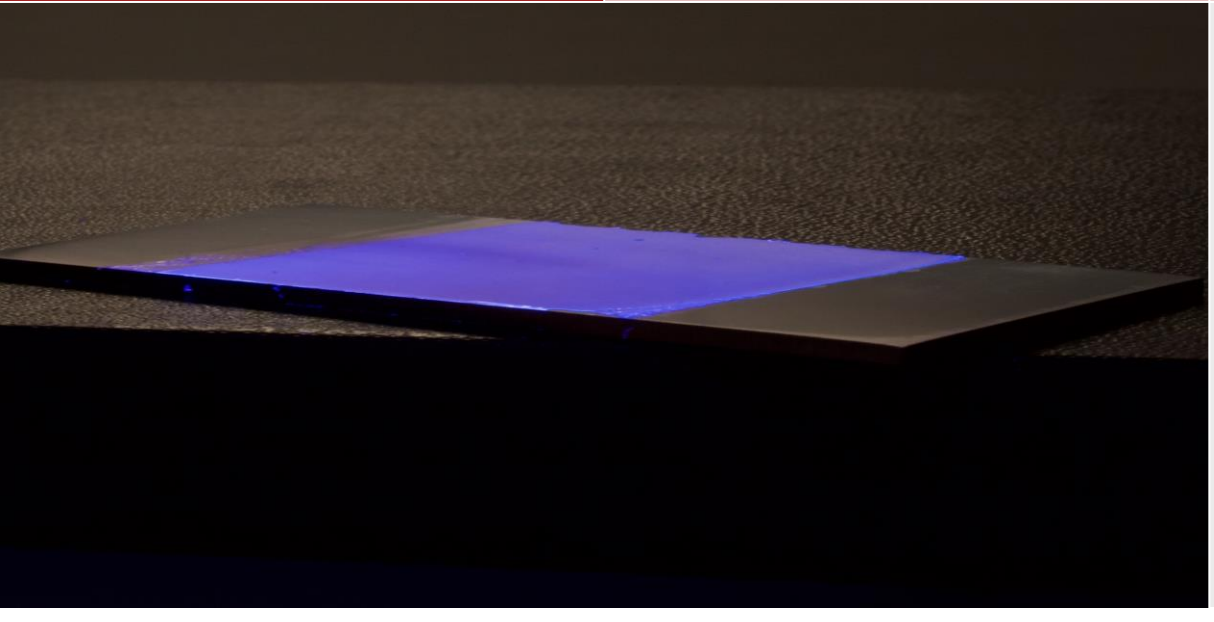
The costs caused by metal corrosion are estimated at up to 4% of global GDP. The products currently on the market cannot prevent corrosion if the coating is defective, and they are not recyclable.

What's the technical solution?

Polymers based on poly(phenylene methylene) can be synthesized in large quantities. They can be processed into anti-corrosion coatings by conventional methods such as hot pressing or spray coating.

What's the use?

The coatings efficiently protect the metal surfaces from corrosion. They are recyclable, stop corrosion in defective areas (self-healing) and they are fluorescent, which helps identify defects.



Multifunctional materials group

Corrosion Engineering & Applied Electrochemistry group (Università degli Studi di Milano)

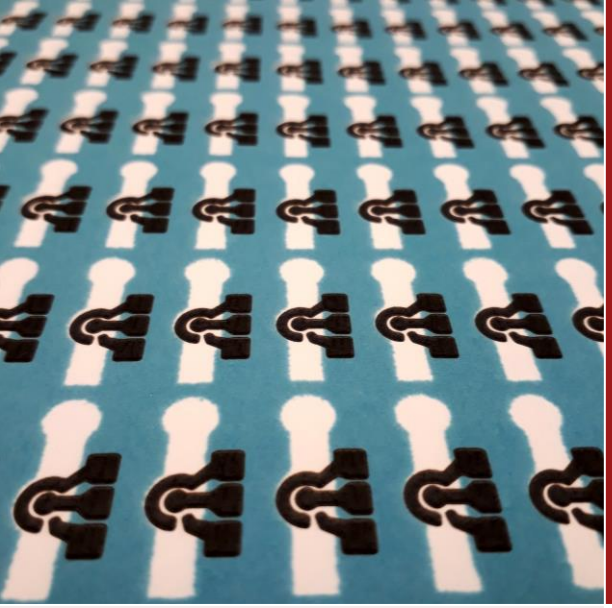
Dr. Marco F. D'Elia

Prof. Walter Caseri

Prof. Markus Niederberger

Dr. Mirko Magni

Prof. Stefano Trasatti



Paper-based electrochemical diagnostics

What's the technical challenge?

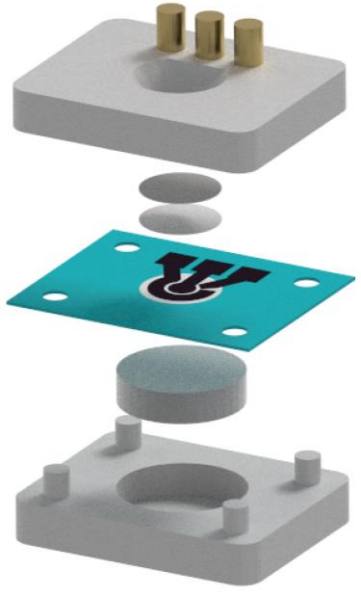
Electrodes are central to realizing quantitative diagnostic assays. Unfortunately, methods for integrating electrodes into paper-based diagnostics are inefficient, expensive and often hinder analytical performance.

What's the technical solution?

We have developed a low cost, scalable and efficient method for making porous electrodes in paper using laser-induced pyrolysis.

What's the use?

Our invention will enable diagnostics developers to seamlessly integrate electrodes into paper-based diagnostic assays, paving the way towards a new generation of point-of-care diagnostic devices.



Nanomaterials Engineering Research Group - Shih group

Institute for Chemical and Bioengineering - deMello group

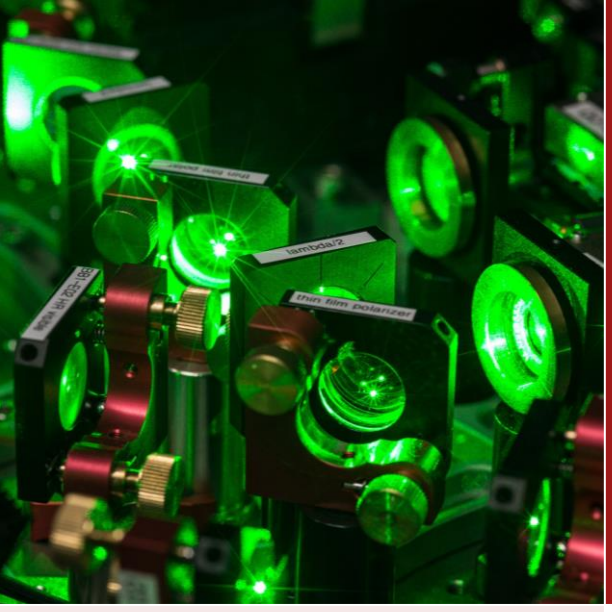
Léonard Bezinge

Prof. Chih-Jen Shih

Prof. Andrew deMello

Dr. Daniel Richards

Dr. Akkapol Suea-Ngam



An accordion superlattice for controlling atom separation in optical potentials

What's the technical challenge?

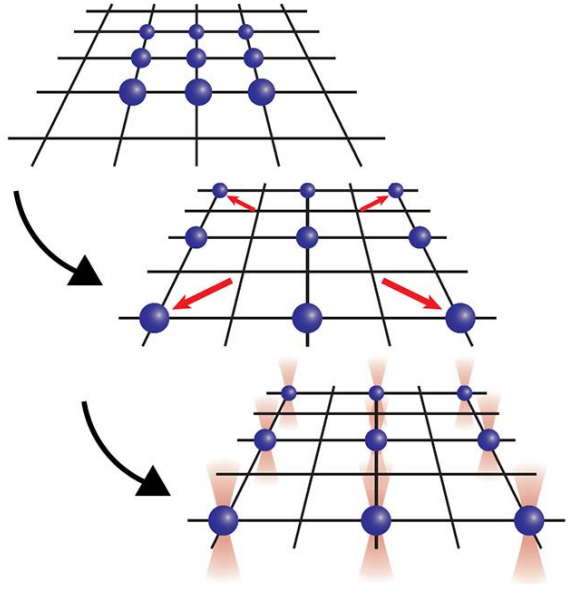
Optical tweezers, each loaded with one atom, are a platform for quantum computation. Typically, these are loaded stochastically, limiting the number of atoms, i.e. qubits.

What's the technical solution?

In a crystal, atoms are deterministically arranged on a grid. Our method allows stretching a crystal until the interatomic spacing is large enough that atoms can be picked up by tweezers one by one.

What's the use?

Current quantum computers have relatively small numbers of qubits, limiting the use cases of these devices. To build more powerful quantum computers, methods for scaling up these numbers are required.



Quantum Optics

Simon Wili

Dr. Konrad Viebahn

Prof. Tilman Esslinger

Lipid nanoparticles as harmless pathogen proxies for transmission monitoring

What's the technical challenge?

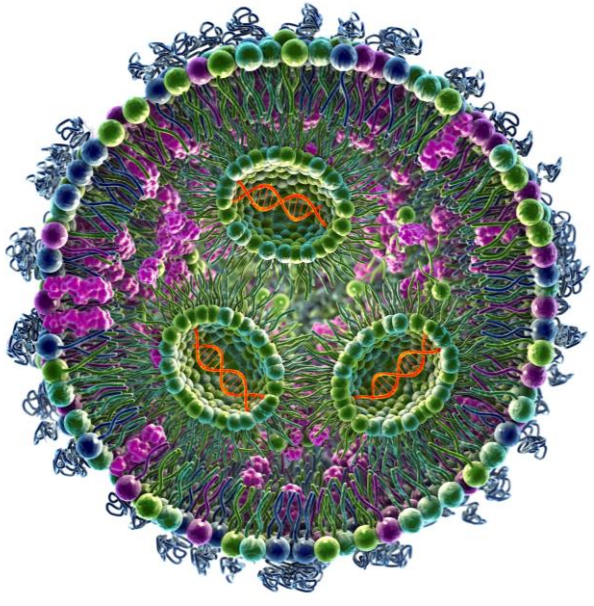
It's not possible to know if a surface has been properly disinfected and decontaminated. That is why in health-care facilities bacteria and viruses are transmitted from hands and surfaces to patients.

What's the technical solution?

Lipid nanoparticles with DNA are used as proxies for bacteria and viruses, as their structure (lipid bilayer membrane) is analogous. DNA enables ultra-sensitive and specific detection via qPCR.

What's the use?

The number of health-care associated infections is lowered because transmission pathways of pathogens and disinfection procedures can now be closely monitored.



Functional Materials Laboratory

Prof. Robert Grass

Lara Pfuderer

Prof. Wendelin Stark

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Fiber-reinforced biodegradable bone cement

What's the technical challenge?

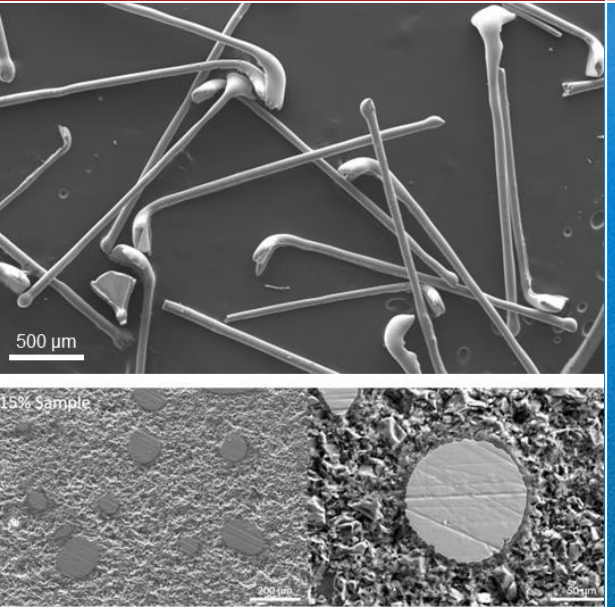
Currently available ceramic-based bone cements have excellent biocompatibility but are unfortunately exceptionally brittle. This diminishes their applicability in load-bearing applications.

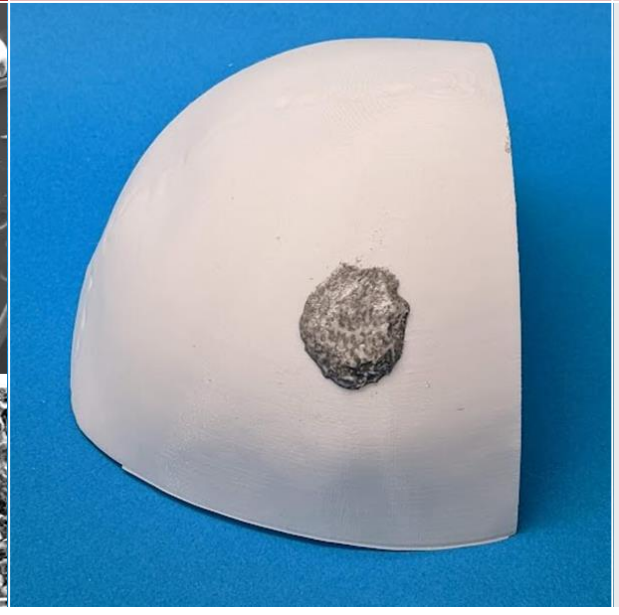
What's the technical solution?

To overcome these limitations, we developed a fiber-reinforced bone cement with enhanced strength and ductility, while at the same time being biocompatible and biodegradable.

What's the use?

The bone cement is osteoconductive and osteoinductive, and reveals excellent injectability, making it very suitable for use in load-bearing orthopedic applications.





Laboratory of Metal Physics and Technology

Laboratory for Orthopaedic Technology

BioMaterial Systems (Uppsala University)

Dr. Leopold Berger

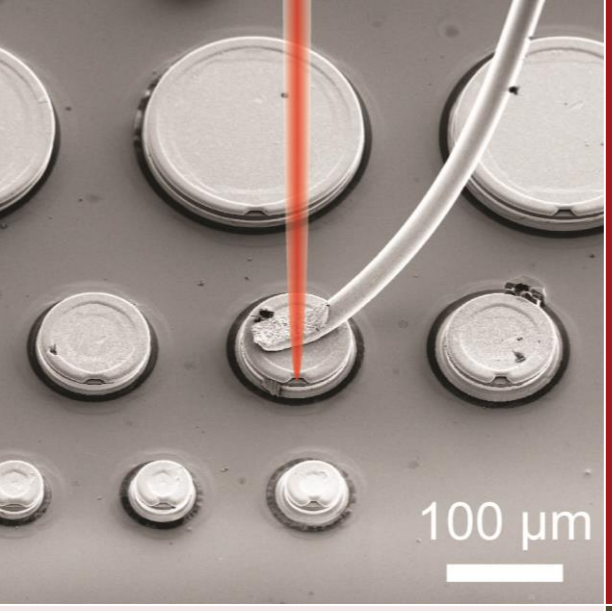
Robin Deller

Prof. Jörg F. Löffler

Dr. Benedikt Helgason

Prof. Stephen Ferguson

Prof. Cecilia Persson



Mid-infrared surface emitting microring quantum cascade laser

What's the technical challenge?

Ring quantum cascade lasers are well-studied devices. However, so far either microlasers in pulsed operation or large area buried heterostructure lasers in continuous wave operation were reported.

What's the technical solution?

Starting from a buried heterostructure ring laser, the outer part is removed and covered with a dielectric-metal mirror. This reduces the active laser area and the optical scattering losses, ultimately reducing the lasing threshold and allowing continuous wave operation.

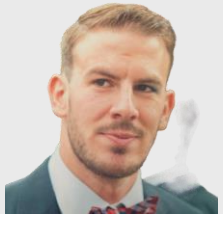
What's the use?

The invented surface emitting microring quantum cascade laser can easily be integrated into portable optical gas sensors due to its low electrical dissipation and superior temperature performance.

Quantum Optoelectronics Group

Prof. Jérôme Faist

David Stark



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Solar receiver delivering heat at 1600°C to decarbonize cement and metals processing

What's the technical challenge?

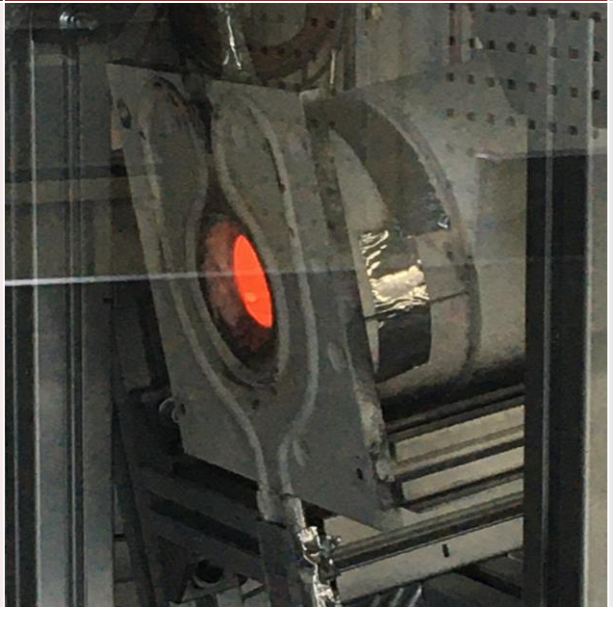
Manufacturing of cement and metals causes 20% of global CO_2 emissions. Concentrated solar techs provide a pathway to decarbonization, but existing solar receivers operate at 600°C max, while these industries need heat above 1000°C

What's the technical solution?

Our invention creates a protective liquid-vapor layer onto the receiver window, increasing efficiency and reliability of the device. Our prototype delivered steam at 1600°C with an unprecedented receiver efficiency exceeding 70%

What's the use?

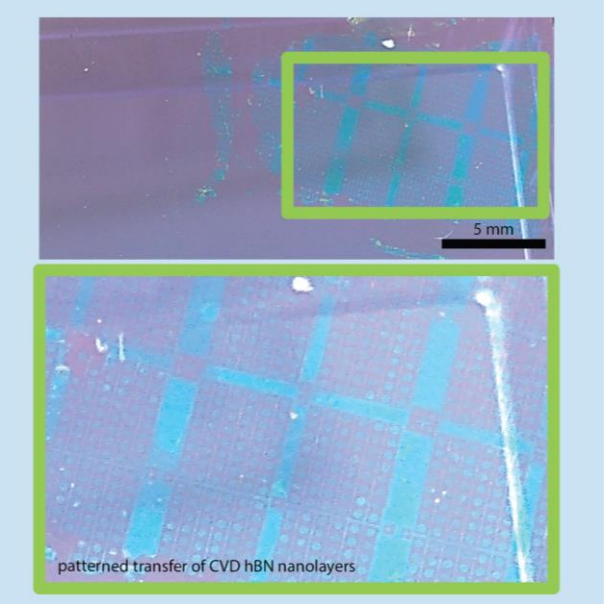
Our invention enables the design of solar receivers capable of delivering heat at T>1000°C with high efficiency. This paves the way towards the solarization of key industries and the achievement of ambitious climate goals



Professorship of Renewable Energy Carriers (PREC)

Dr. Emiliano Casati

Prof. Aldo Steinfeld



A direct method for 2D material-based nanolayer integration for hybrid technologies

What's the technical challenge?

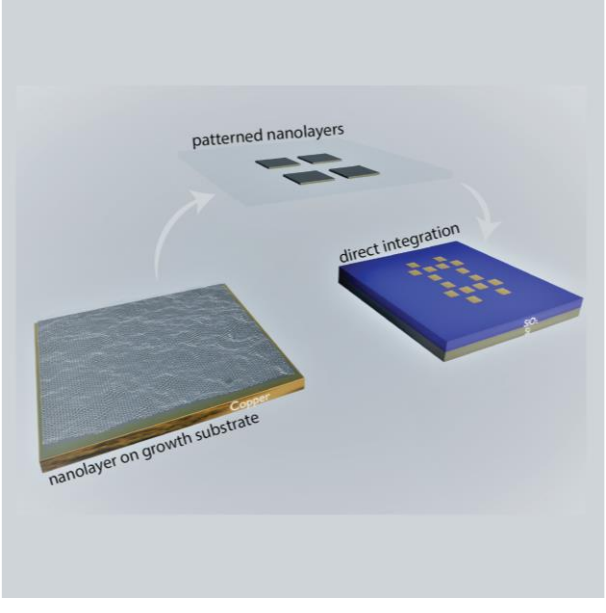
Processing methods and conditions significantly influences the device performance of 2D material-based electronic devices. Minimal contamination is key to boost the performance metrics.

What's the technical solution?

Layer-by-layer approach to encapsulate 2D materials minimizes exposure to contamination. Pre-patterning heterostructures into devices on their intrinsic substrates is a robust method for direct integration.

What's the use?

Pre-patterned heterostructures can be used as high-performance sensors and other essential building blocks. This approach offers an effective means for 2D material-based heterostructure integration.



Micro- & Nanosystems (MNS)

Dr. Kishan Thodkar

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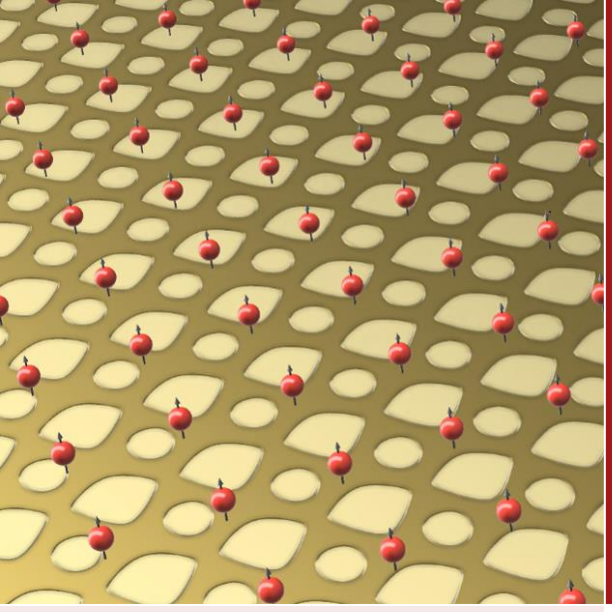
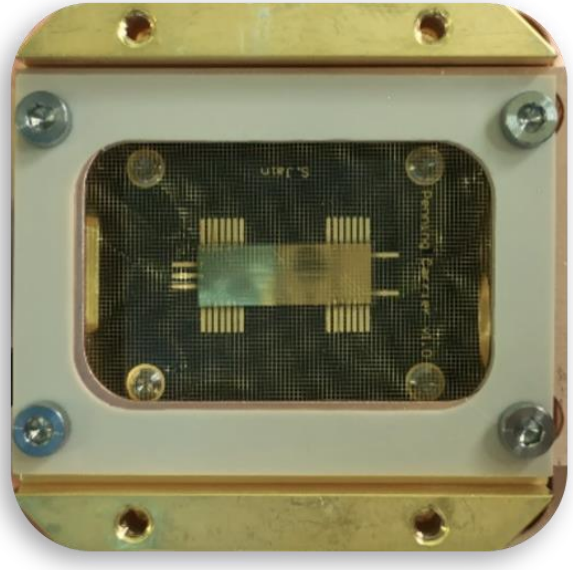


Scalable two-dimensional quantum computing architecture

What's the technical challenge?
Trapped atomic ions have shown great potential to power universal quantum computers of the future. The challenge with currently established approaches is to design an architecture that can scale to millions of qubits.

What's the technical solution?
Our architecture breaks the paradigm of using radio-frequency fields to trap ions in microfabricated trap chips. Instead, we use purely static fields, significantly relaxing operational constraints and enhancing scalability.

What's the use?
The applications of quantum computing have the potential to revolutionise various domains such as medicine, material design, energy, cryptography, logistics and beyond.



Trapped Ion Quantum Information (TIQI)

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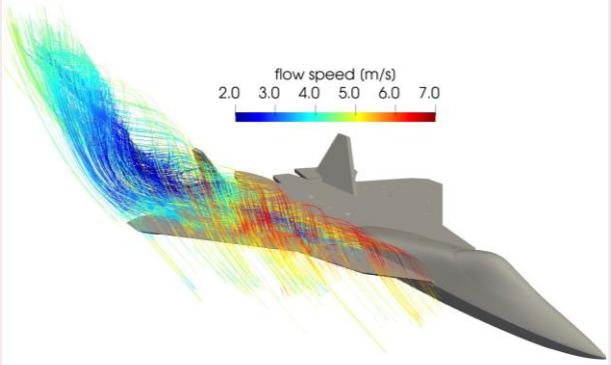
Real-time flow visualization with event-based cameras

What's the technical challenge?
Classical quantitative flow visualization requires expensive equipment, long setup and post-processing times, and generates very large amounts of data preventing its routine application in aerodynamic testing.

What's the technical solution?
The invented measurement system uses multiple event-based cameras and an efficient data processing pipeline to reconstruct and visualize complex flow fields in real-time by tracking small particles introduced in the flow.

What's the use?
As measurement results are available instantaneously, the invention enables test engineers to modify aerodynamic configurations and receive instant feedback, significantly accelerating the design iteration process.



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