TECHNISCHE UNIVERSITÄT DRESDEN

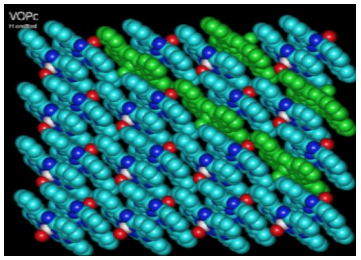
DRESDEN concept

Institut für Angewandte Physik

Happening 14.12.2020

Institut für Angewandte Physik

- Grundlagenforschung in der Festkörperphysik und Photonik
- Brücke zur Anwendung wird geschlagen: Zahlreiche Ausgründungen
- Größtes und drittmittelstärkstes Institut der Fachrichtung
- Enge Kooperation mit anderen Fachrichtungen



Institut für Angewandte Physik

›Professur für Experimentalphysik / Photophysik
Prof. Dr. Lukas Eng

›Professur für Optoelektronik
Prof. Dr. Karl Leo

›Professur für Organische Halbleiter
Prof. Dr. Sebastian Reineke

Professur für Neuartige Elektronik-Technologien
(cfaed)
Prof. Dr. Yana Vaynzof

Professur für Spektroskopie in der Halbleiterphysik
(gemeinsame Berufung, HZDR)
Prof. Dr. Manfred Helm

Professur für Quantenoptik
(gemeinsame Berufung, HZDR)
Prof. Dr. Roland Sauerbrey

›Außerplanmäßige Professur
Prof. Dr. Ellen Hieckmann

›Professur für Materialwissenschaft und Nanotechnik
(Zweitmitglied, ›Fakultät Maschinenwesen)
Prof. Dr. Gianaurelio Cuniberti

›Professur für BioNanoTools
(Zweitmitglied, ›CMCB)
Prof. Dr. Stefan Diez

Professur für Zelluläre Maschinen
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Prof. Dr. Jochen Guck

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Prof. Dr. Kornelius Nielsch

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Prof. Dr. Michael Schlierf

Honorarprofessur für Nanophysik
(IFW)
Prof. Dr. Oliver G. Schmidt

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Hauptamtlich berufen

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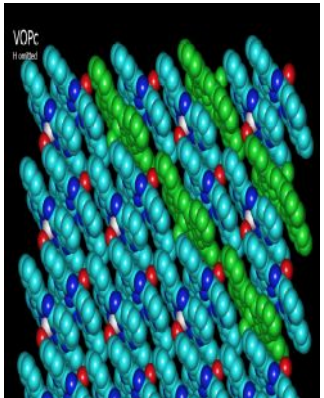
Kurze Vorstellung der Forschung

- Für detaillierte Informationen:
- TU-Webseiten
- Informationsveranstaltung:
  2. Termin wird bekanntgeben
- Gespräche mit Mitarbeitern



Eng-group Research

DRESDEN concept

Optical, electronic, topological, magnetic properties of novel, functional nanomaterials for applications in nanoscale electronics and optoelectronics, etc.

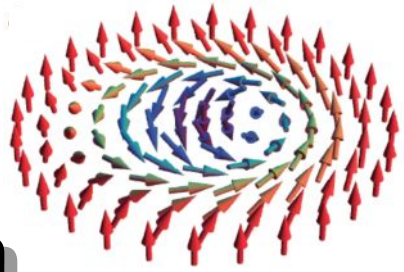
org./bio molecule

SKY-team

SNOM-team

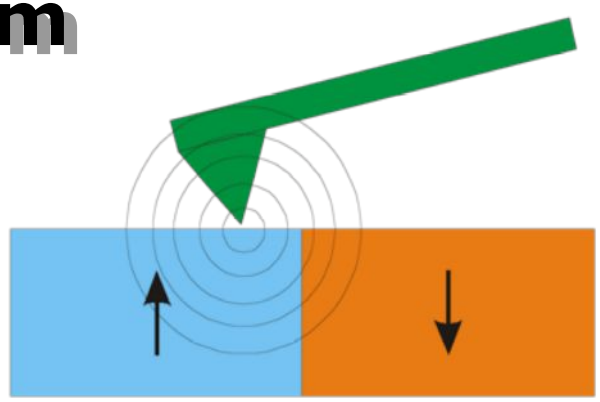
FERROIX-team

SPEX-team



plasmon phonon polariton

multi-ferroic



www.tu-dresden.de/mn/physik/iap lukas.eng@tu-dresden.de

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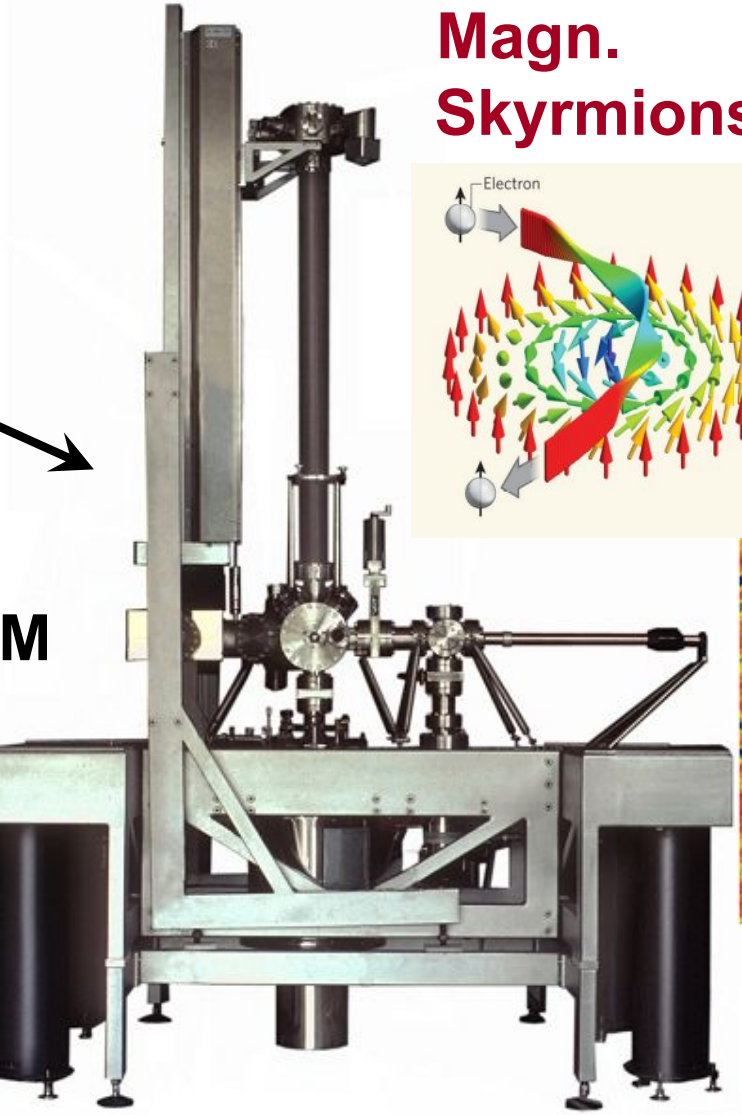
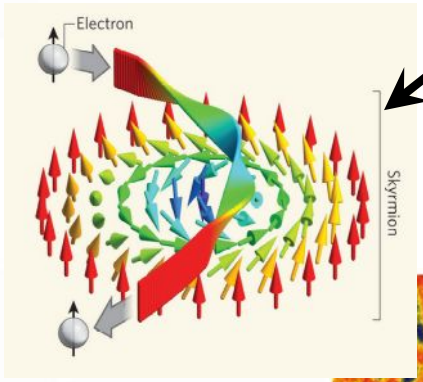
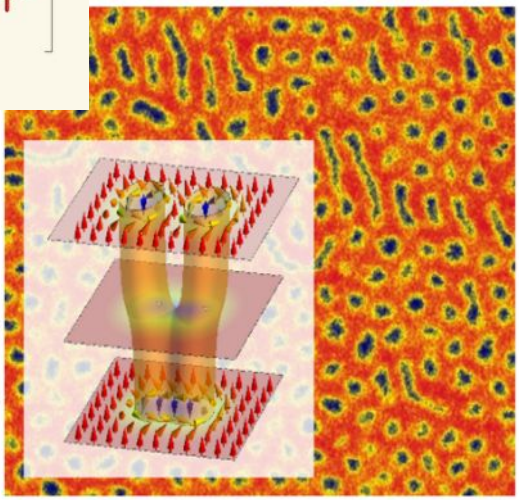
SKY-team

DRESDEN concept



Magn. Skyrmions





Cryogenic UHV-SFM
UHV, T > 5 K, 8 T

- ferromagnetic, ferro electric morphology
- domains
- phase transitions
- hedgehogs & skyrmions

=> Racetrack Memory

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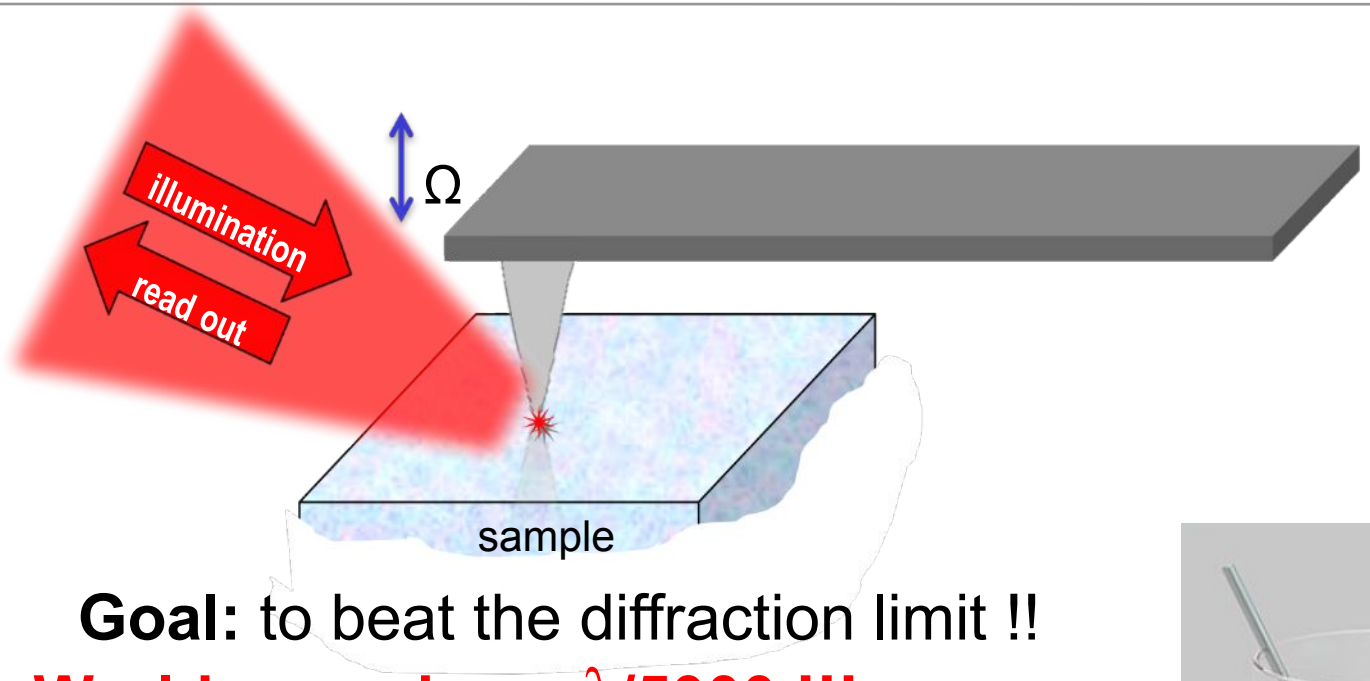
SNOM-team

s-SNOM: scattering scanning near-field optical microscopy

DRESDEN concept



Goal: to beat the diffraction limit !!

World-record: $\lambda/5000$!!!

- scattering
- Raman
- absorption
- fluorescence
- ...

Cloaking

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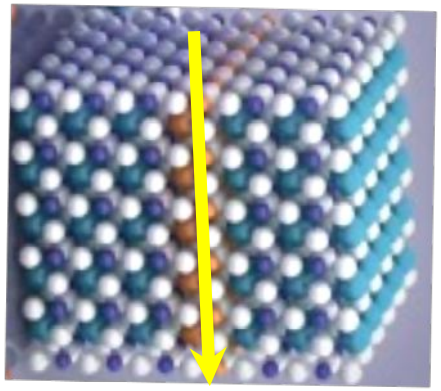
FERROIX-team

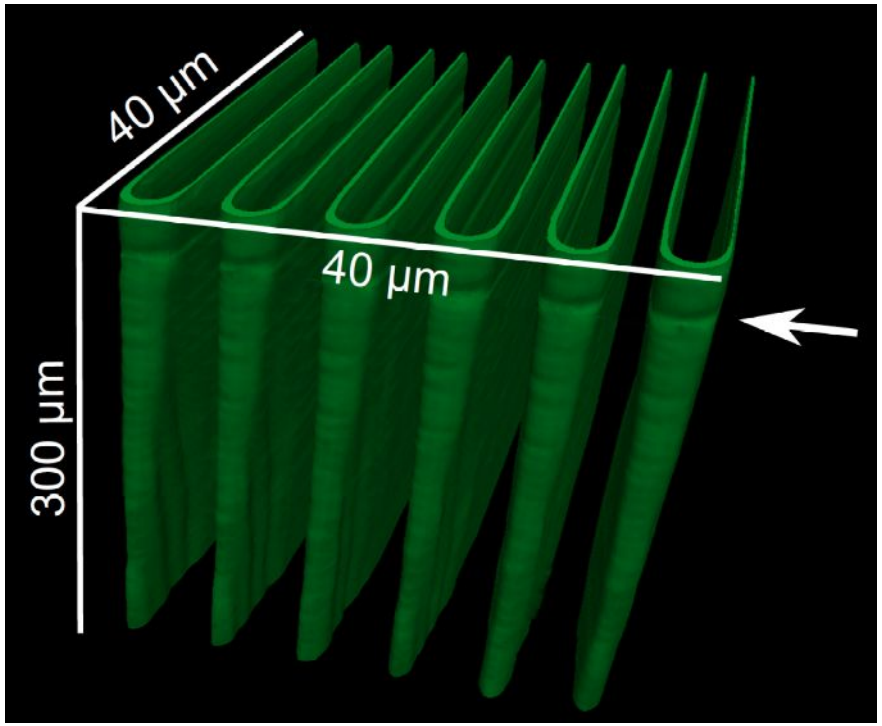
DRESDEN concept

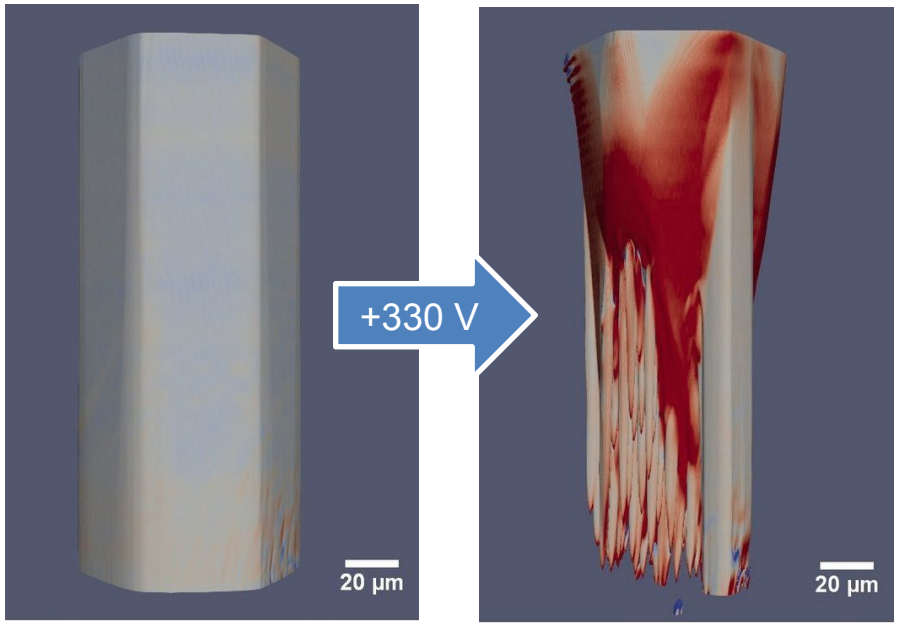
- Charged domain walls
- 2D electron gases
- Bottom-up self-assembly



h2h

t2t

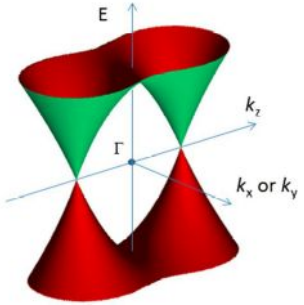


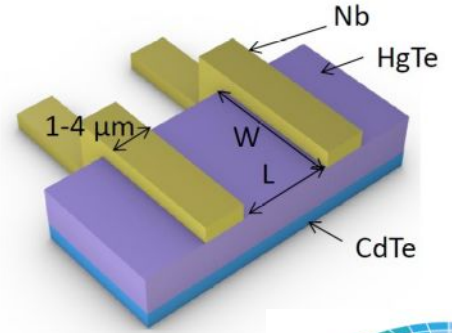


visualized by **Cerenkov-SHG**

B. Kirbus et al., *ACS* (2019)

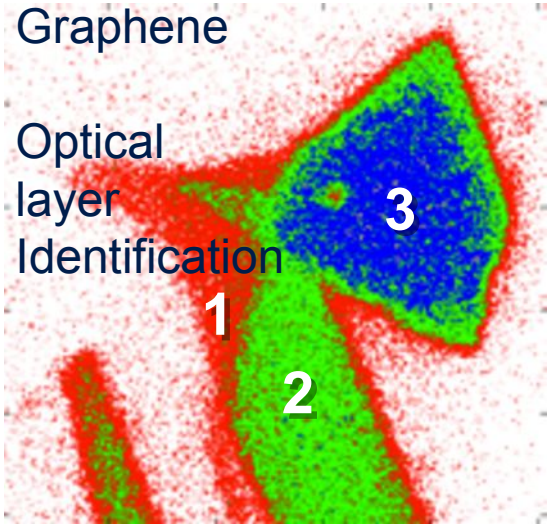
- Spectroscopy of ***2D Materials***:
  - Dirac materials (graphene)
  - Weyl semimetals (WTe_2)
  - transition dichalcogenides ($MoSe_2$, …)
  - metal-organic frameworks (MOFs, COFs)
  - domain walls ($LiNbO_3$, …)
  - topological Insulators (HgTe, CdTe,…)

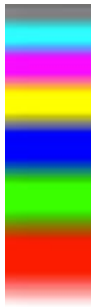


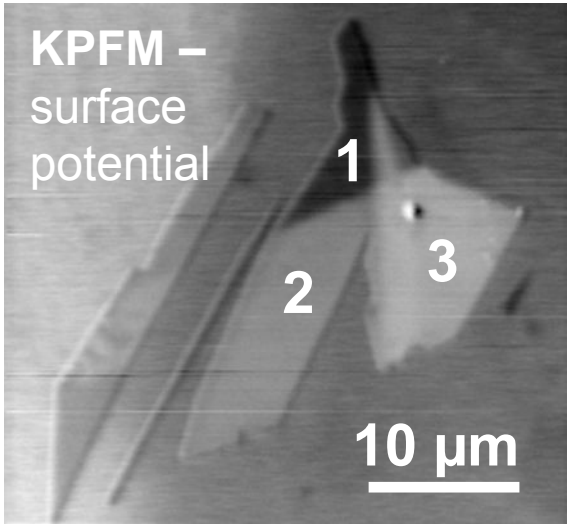


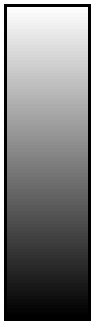
- Optoelectronic devices:
  - Hall sensors
  - photo switches
  - memories, …

ct.qmat









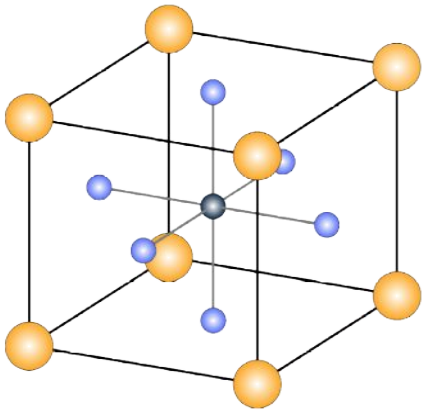
Work on organic semiconductors

- **Karl Leo**
- Physics Diploma Univ. Freiburg/Germany 1985
- PhD Univ. Stuttgart 1988
- AT&T Bell Labs Holmdel 1989-1991
- RWTH Aachen 1991-1993
- TU Dresden 1993
- Co-founder of Novaled, Heliatek and 6 other spin-offs

- **Sebastian Reineke**
- Physics Diploma TU Dresden/Germany 2005
- PhD TU Dresden 2010
- Postdoc MIT, Cambridge, 2011-2013
- Visiting Scientist LMU Munich 2013-2014
- TU Dresden 2014

- **Yana Vaynzof**

- B.Sc. in Electrical Engineering, Technion – Israel Institute for Technology 2006
- M.Sc. in Electrical Engineering, Princeton University, USA 2008
- PhD in Physics, University of Cambridge 2011
- Postdoc University of Cambridge 2011-2013
- Juniorprofessorin (Physics), Heidelberg 2014-2018
- TU Dresden seit 2019



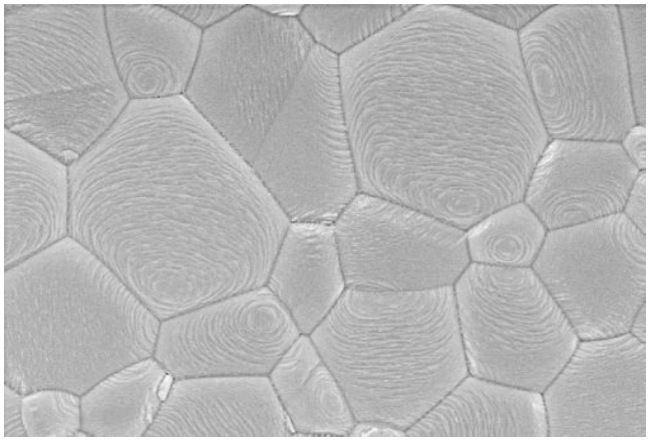
ABX_3

$A = CH_3NH_3^+$

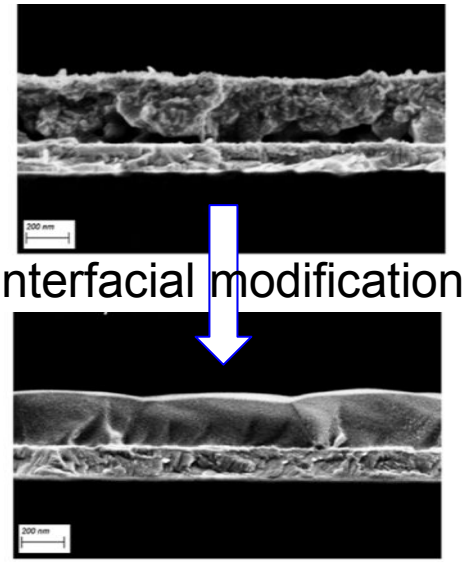
$B = Pb^{2+}, Sn^{2+}$

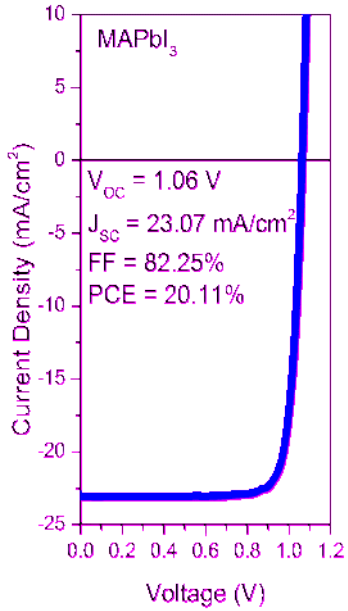
$X = I^-, Br^-, Cl^-$

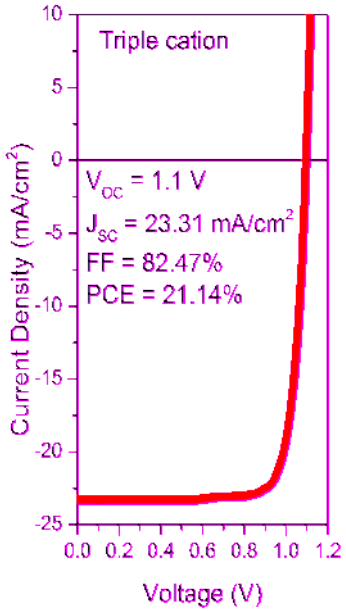
$CH_3NH_3PbI_3$



- Electronic structure
- Interfacial design
- Stability
- Hysteresis
- Reproducibility

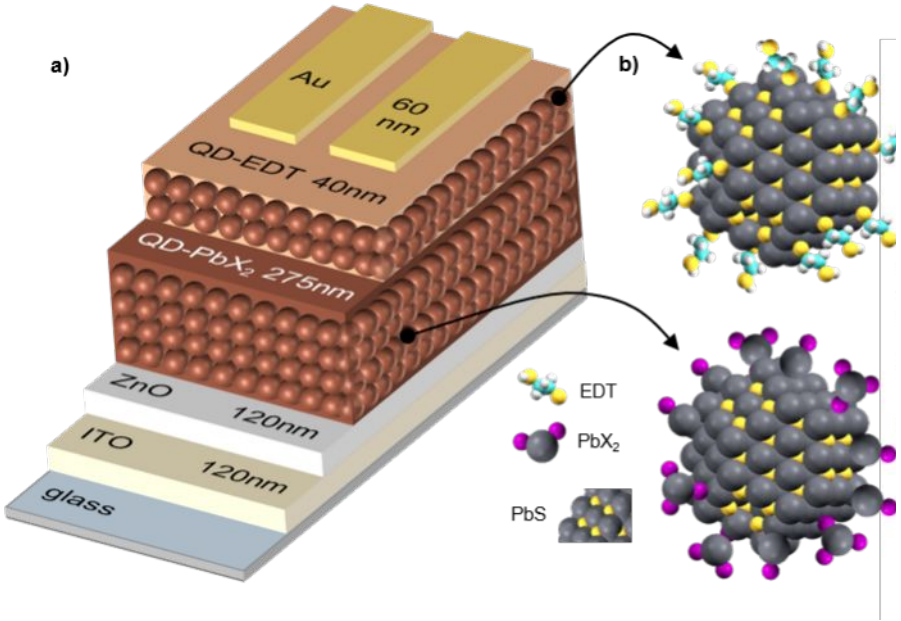


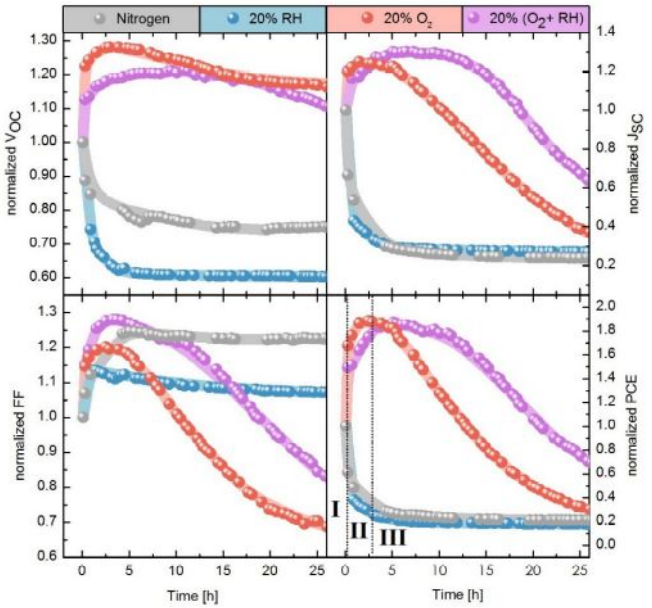




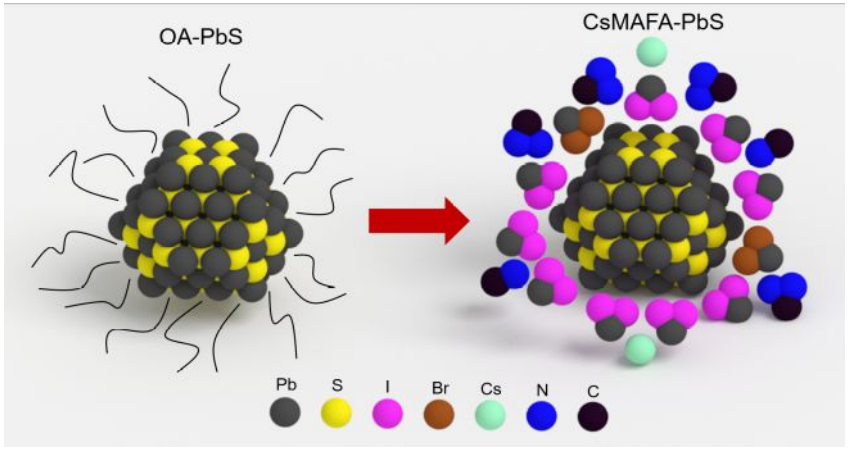
Adv. Energy Mater. **7** (20), 1700977 (2017)
Nano Energy **39**, 400 (2017)
ACS Appl. Energy Mater. 1 (2), 676 (2018)
Energy Environ. Sci. **11**, 3380 (2018)
ACS Appl. Mater. Interfaces **11** (2), 2490 (2019)
Adv. Energy Mater. **9** (33), 1901257 (2019)

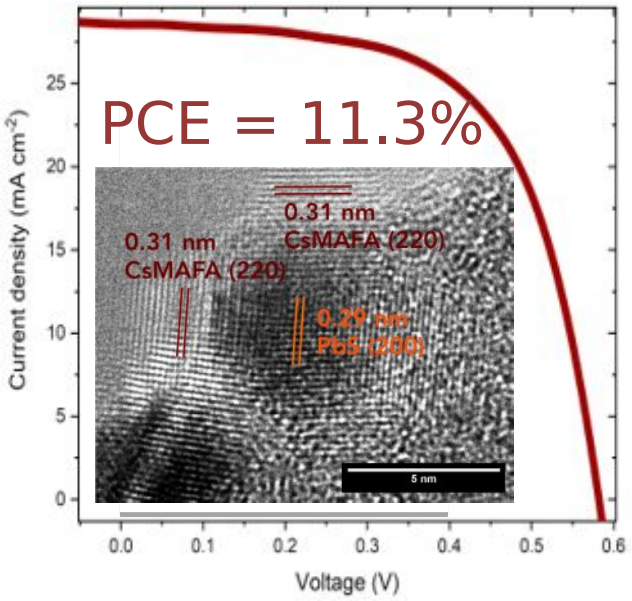
- **Stability of PbS solar cells**



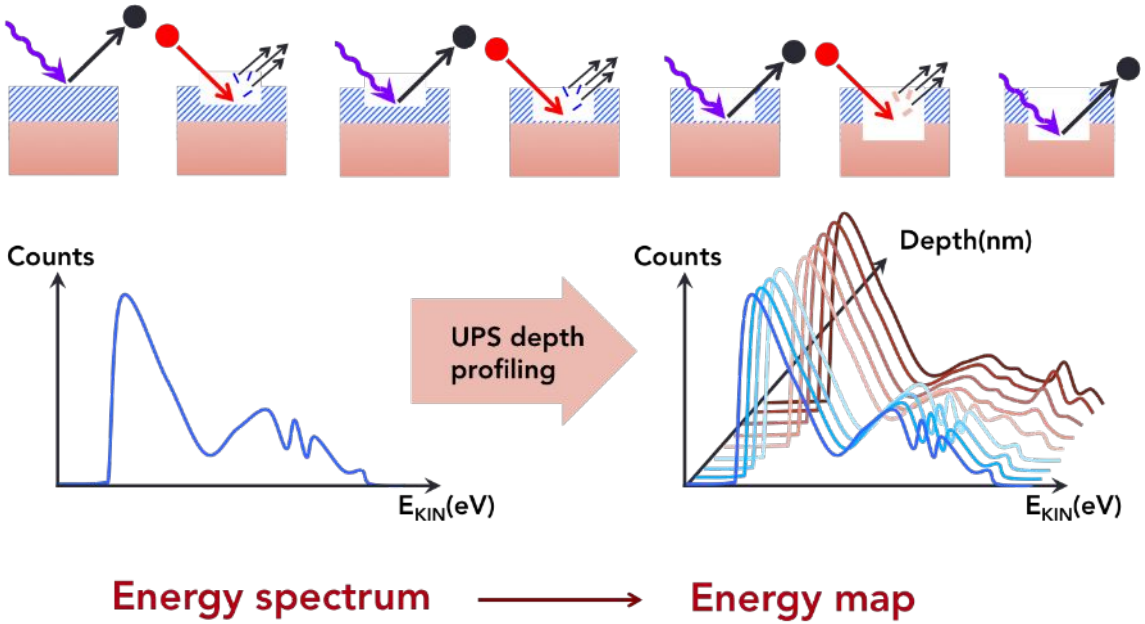


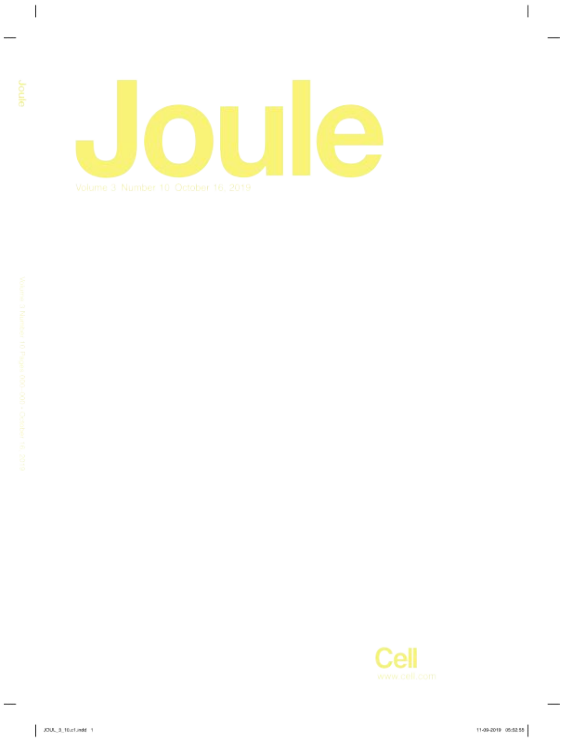
- **Hybrid perovskite/PbS solar cells**





- **Method development - UPS depth profiling**

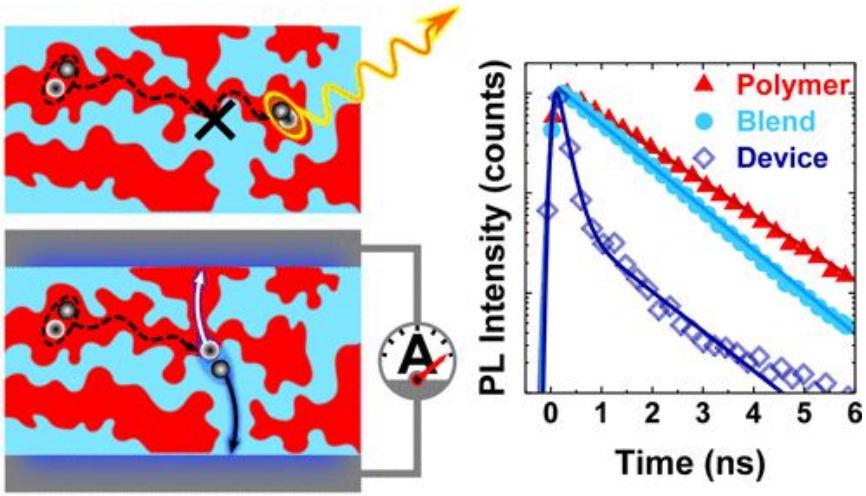




- Ultra-violet Photoemission Spectroscopy (UPS) in combination with Gas Cluster Ion Sources (GCIS) for material etching
- Probing the energetic landscape of devices
- Energetic and compositional information on a ~1 nm resolution

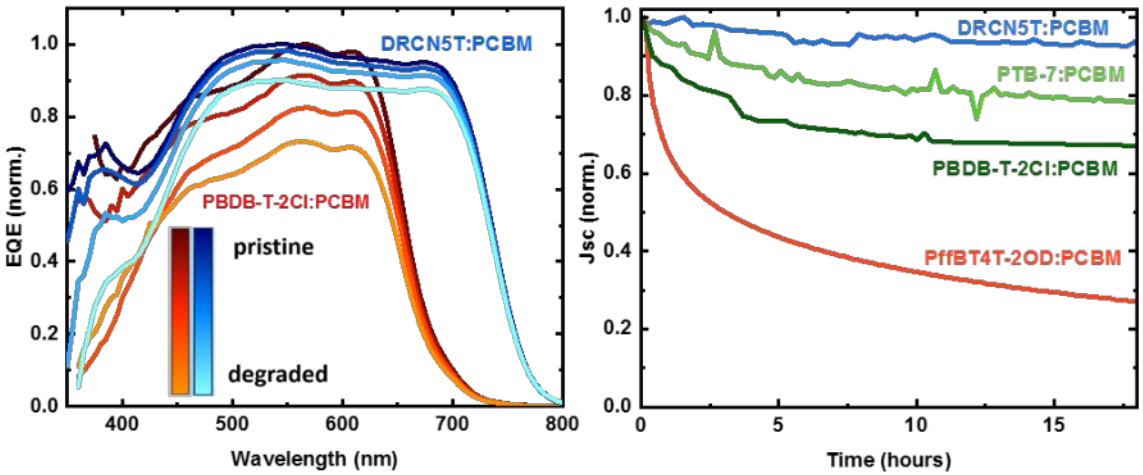
Joule, in press (2019)
ACS Appl. Polym. Mater. **16**, 1372 (2019)
Org. Electron. **67**, 1 (2019)
Adv. Energy Mater., in press (2019)

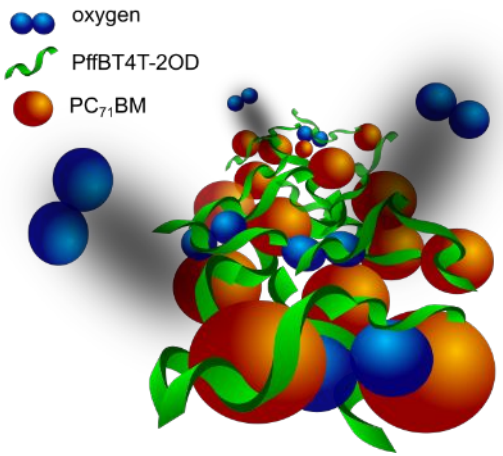
- **Photophysics of BHJ solar cells**



- Non-fullerene acceptors
- Low energy offset systems
- Ternary blends
- Stability

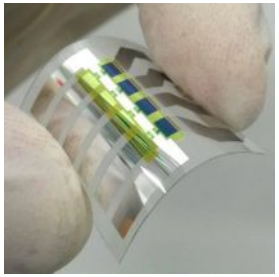
- **Stability of BHJ solar cells**





Chem. Mater. **30**, 8, 2660 (2018)
ACS Appl. Energy. Mater. **2**, 1943 (2019)

Vanyzof & Leo: Organic solar cells

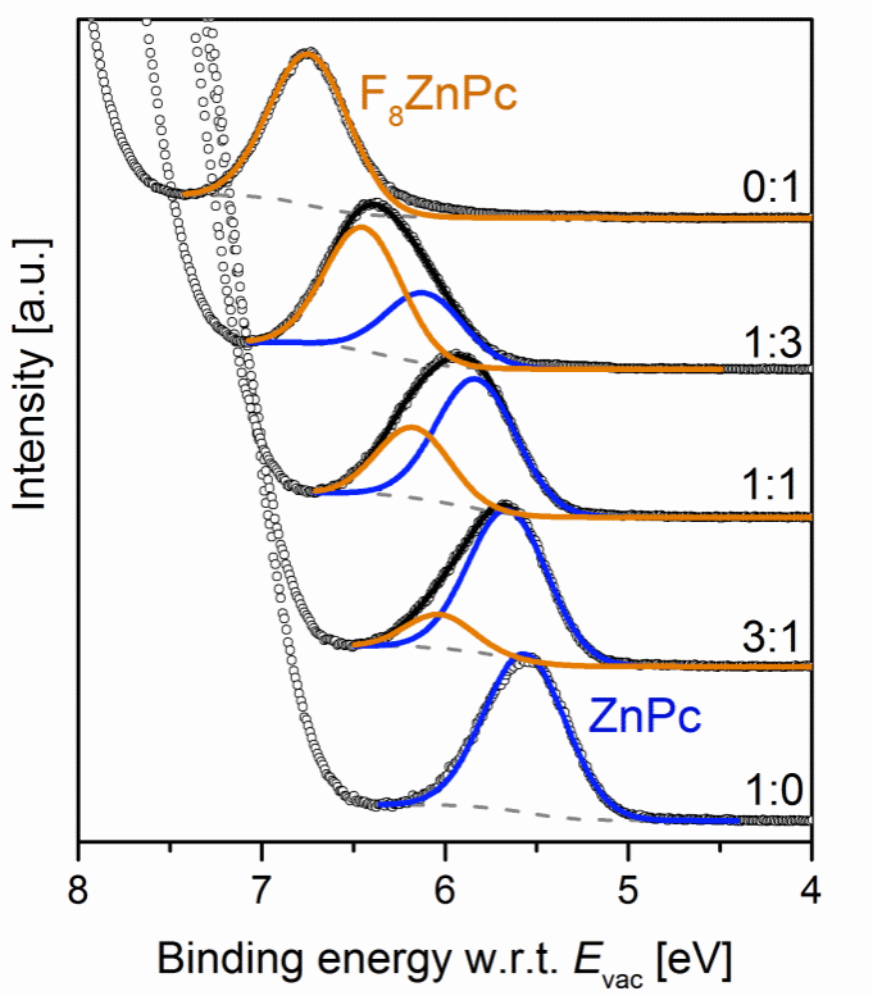


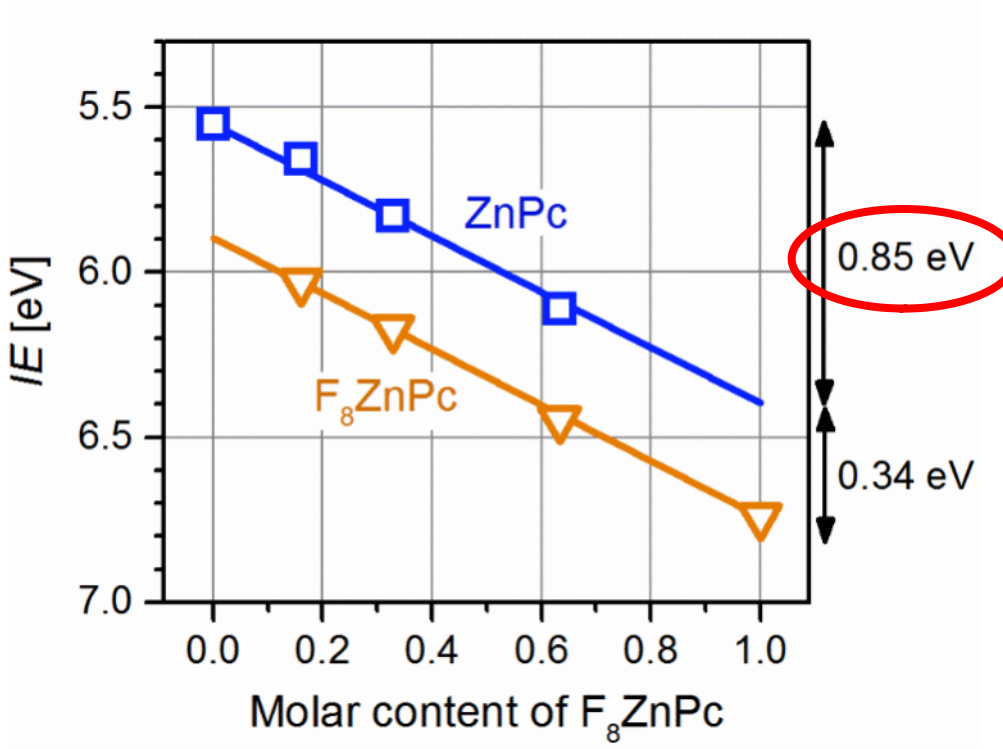
- **New device architectures - concepts**

- **Upscaling**
  - Transparent electrodes
  - Encapsulation
  - Lifetime

- **Novel Electrodes and Encapsulation**

Leo: Basic research on organic semiconductors

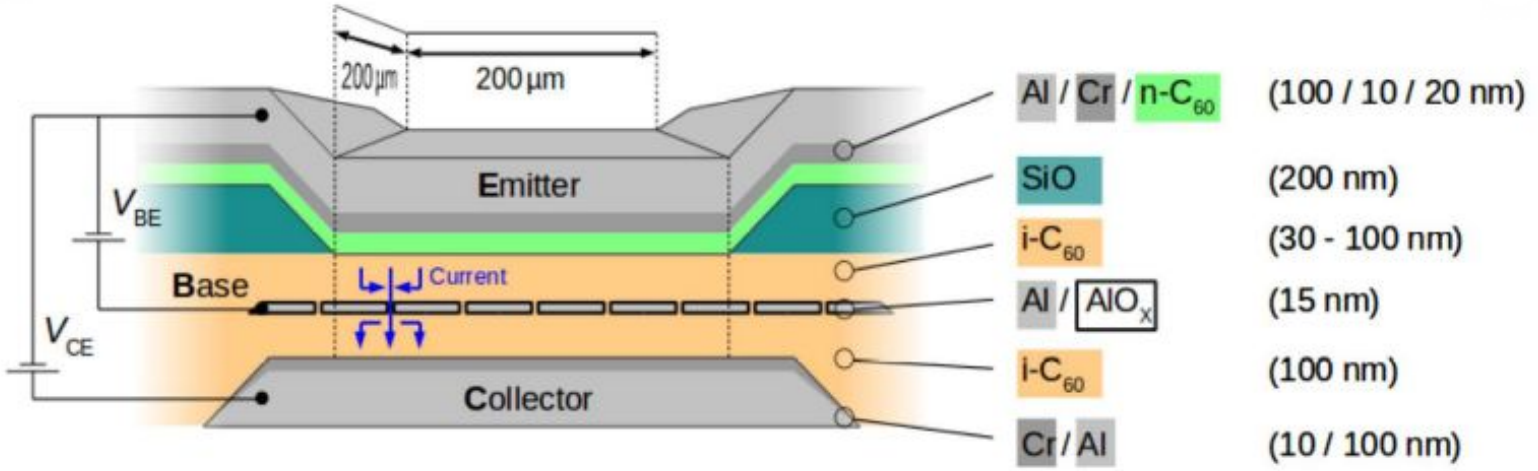


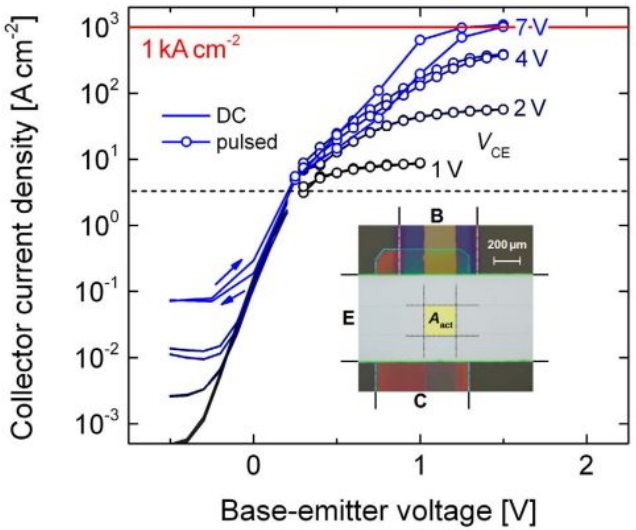


Continuous tuning with quadrupole moments

Schwarze et al., Science 352, 1446 (2016)

Leo: Work on novel transistors

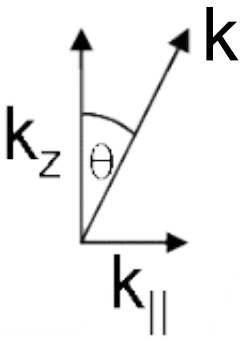


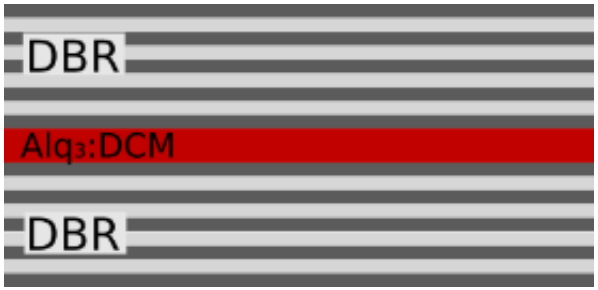


M. Klinger et al. Nat. Sci. Rep. 10.1038/srep44713

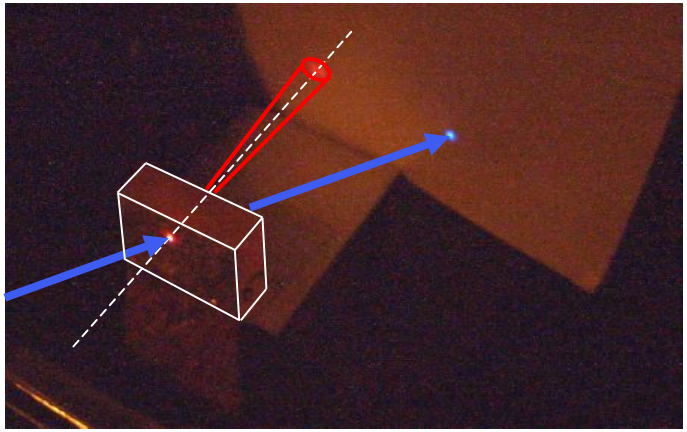
Organic Microlasers

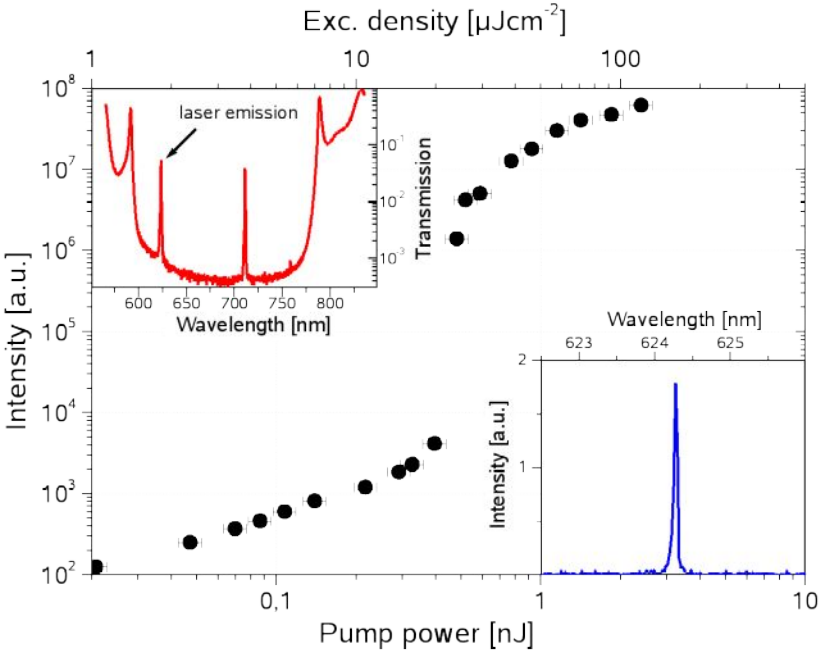
- Microcavity based on DBR
- Highly efficient lasers and detectors
- Topological Photonics



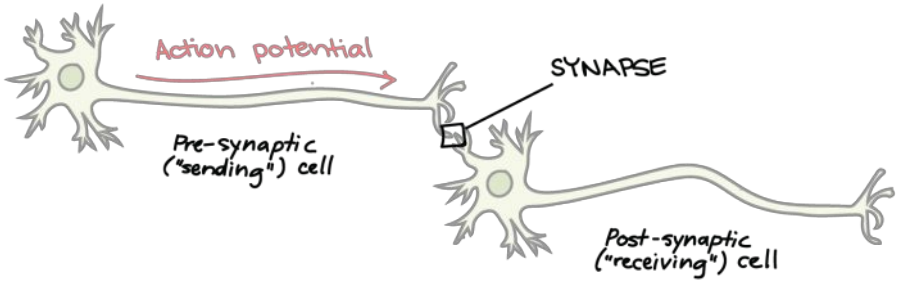


ct.qmat
Complexity and Topology in Quantum Matter

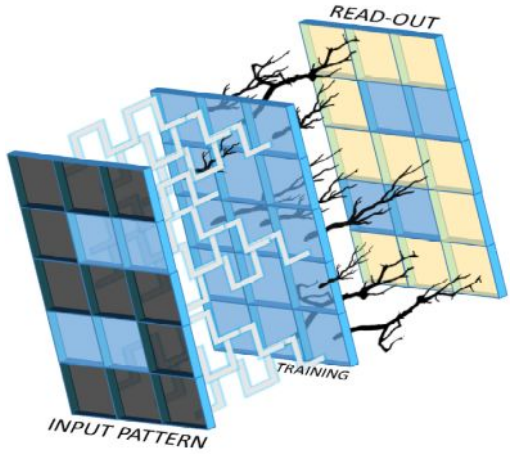


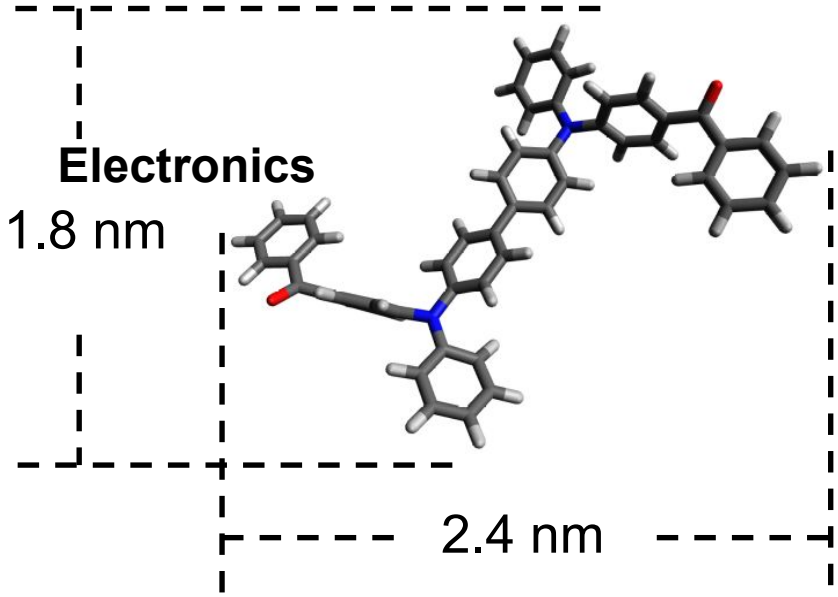


Leo: Bioelectronics and Neuromorphics



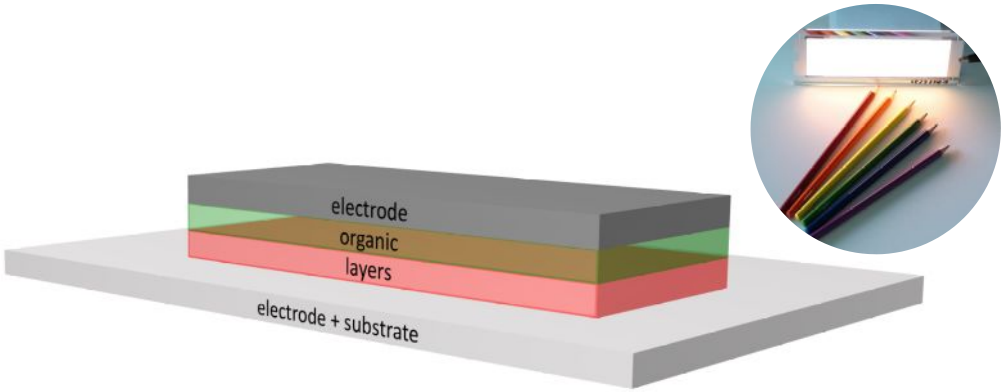
- Highly interconnected polymer networks grown by electropolymerisation
- Network resembles the geometry and function of synapses
- Artificial Neuronal Networks
- Build the „polymer brain“

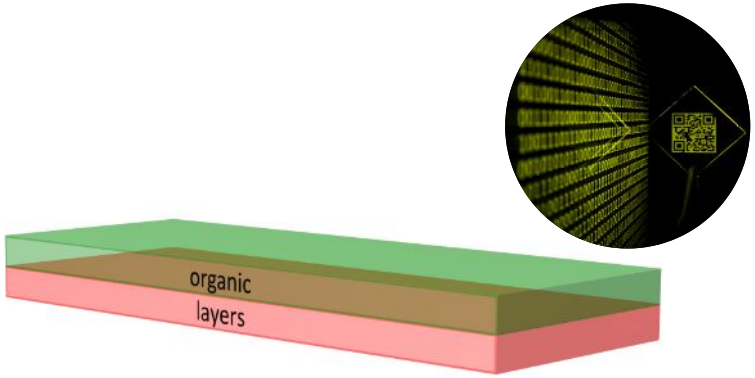




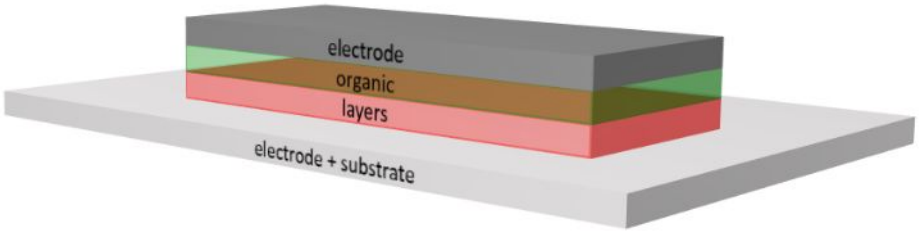
Organic semiconductors:
nanoscale building blocks

Organic electronics and photonics: Microscale applications





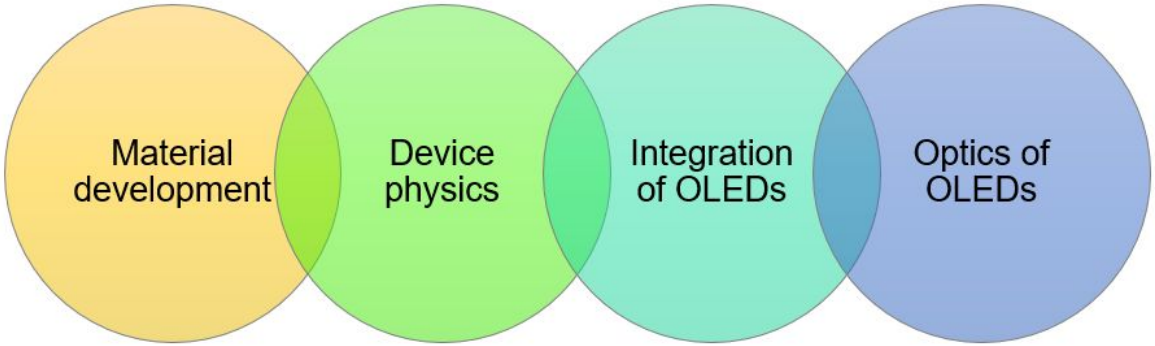
Organic light-emitting diodes (OLEDs) **= ultrathin, scalable area light sources**



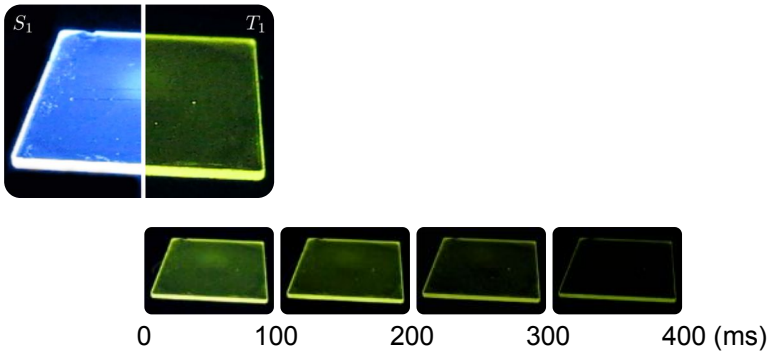
Cost

Efficiency

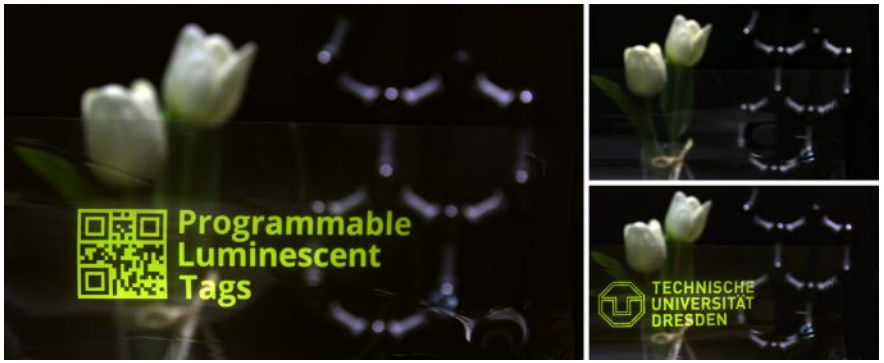
Lifetime

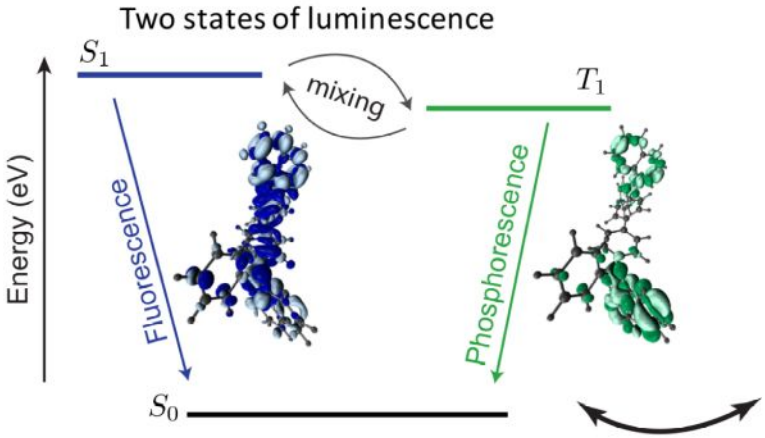


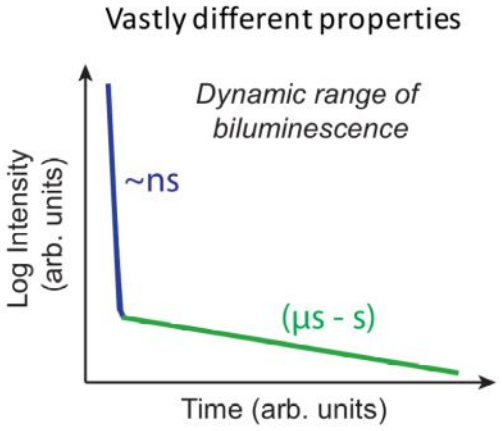
Biluminescence **= dual state luminescence from singlet and triplet states**



Organic programmable luminescent tags



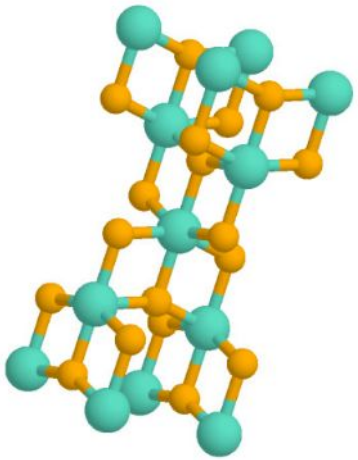


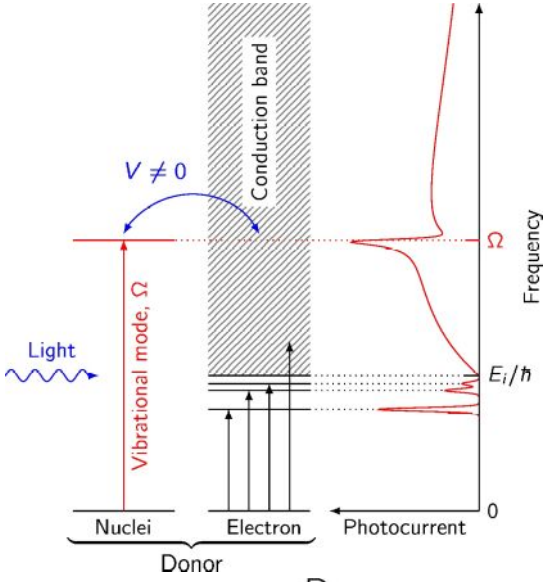


Bicycle safety

Semiconductor oxides:

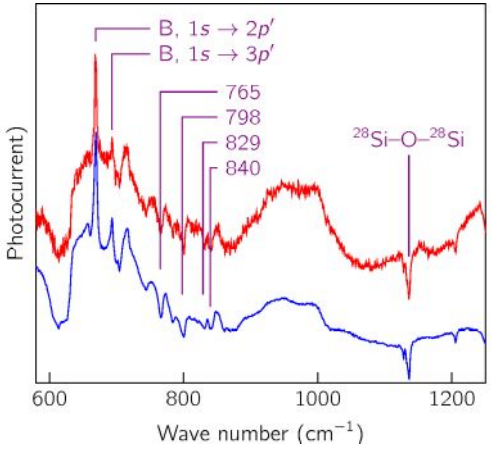
- ZnO
- Anatase TiO_2
- Rutile TiO_2
- SnO_2

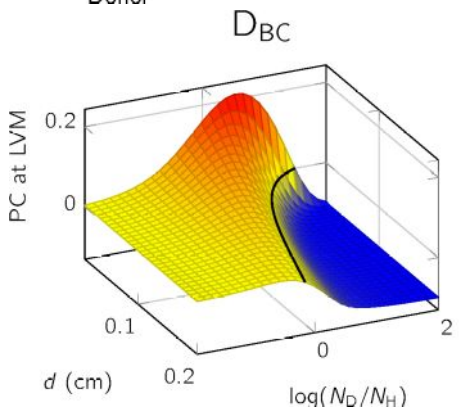




Methods:

- IR absorption
- Raman scattering
- Photocurrent
- Photoluminescence
- Capacitance spectroscopy





Material physics in a scanning electron microscope

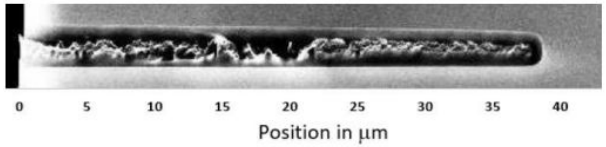
Contact:
Prof. Dr. Ellen Hieckmann
REC C 212, 0351/ 46336051
ellen.hieckmann@tu-dresden.de,
SEM lab REC B1

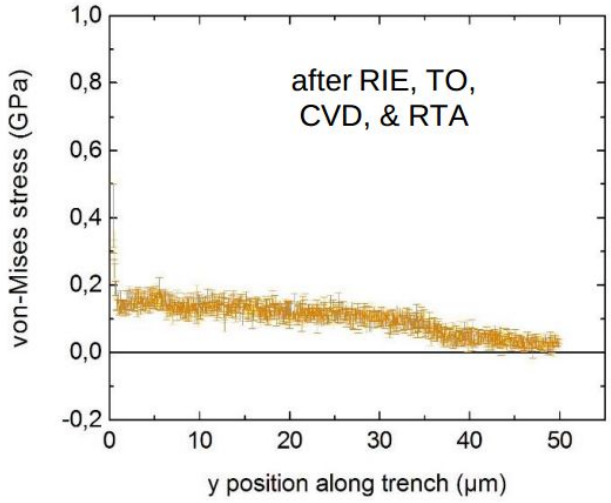
Faculty of Science, Faculty of Physics, Institute of Applied Physics

Investigation of structure and properties of different material classes

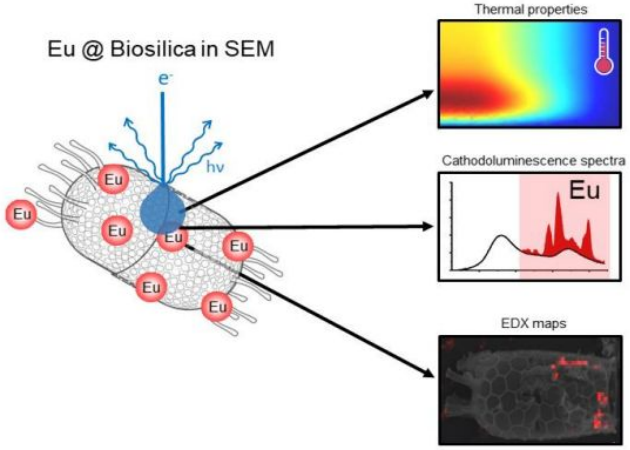
Examples:

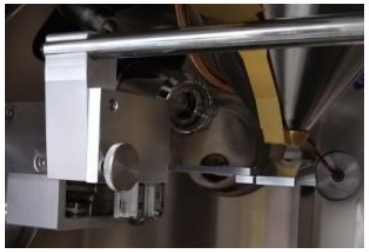
Determination of mechanical stresses in deep trenches of processed Si wafers by cross-correlation electron diffraction





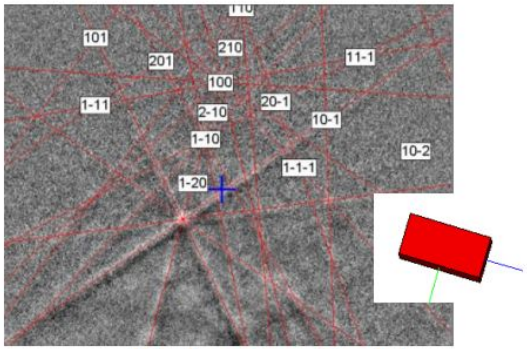
Detection and localization of Eu on biosilica by analytical scanning electron microscopy





recently developed parabolic mirror for cathodoluminescence investigations

Orientation determination in crystalline regions of organic semiconductors



Rubrene $C_{42}H_{28}$

You will be introduced into the operation of an SEM!

Forschung am HZDR (Prof. Manfred Helm)

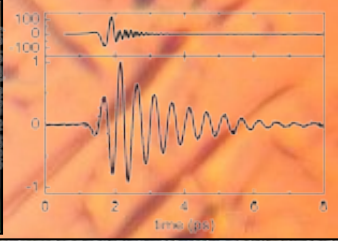
HZDR
HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

Wir bieten vielfältige Themen aus den Bereichen:

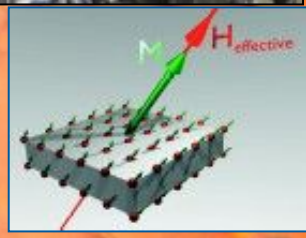
- Ultrakurzzeit- und Terahertz-Spektroskopie, u.a. mit dem Freie-Elektronen-Laser
- Halbleiter-Quantenstrukturen
- Halbleitermaterialsynthese & -Modifikation mit Ionenstrahlen: Spintronik, Nanodrähte für die Nanoelektronik
- Nanostrukturierung mit Elektronenstrahl-Lithographie (& Reinraum)
- Computer-Simulation, u.v.m.

und drumherum

- eine hervorragende Infrastruktur
- modernste und vielfältigste Messtechniken
- mehr als 50 erfahrene Doktoranden und Postdocs



Bachelor- und Masterarbeiten möglich ! (www.hzdr.de/fwi)

Vielen Dank!

Laborführungen: Termin wird bekannt gegeben

Erste Eindrücke aus Laboren

https://tud.link/4xbq
http://www.jove.com/video/53872

Laborführungen: Termin wird bekannt gegeben