

Department Life, Light and Matter



Poster pdf-file

RESEARCH – LONG TERM – VISION Atomic and Molecular Scale Sensing

Molecular Sensing

Analyzing and disentangling molecular interactions in ultra-complex mixtures

Effects, structures and properties of/in complex mixtures; separation of complex mixtures

Quantum Sensing

Sensing of nanoobjects such as clusters, nanostructures and biological components

Biomolecular complexes, imaging of quantum systems
nanomaterials via NMR, TEM/ EELS

Cellular Sensing

Local cellular response to external stimuli

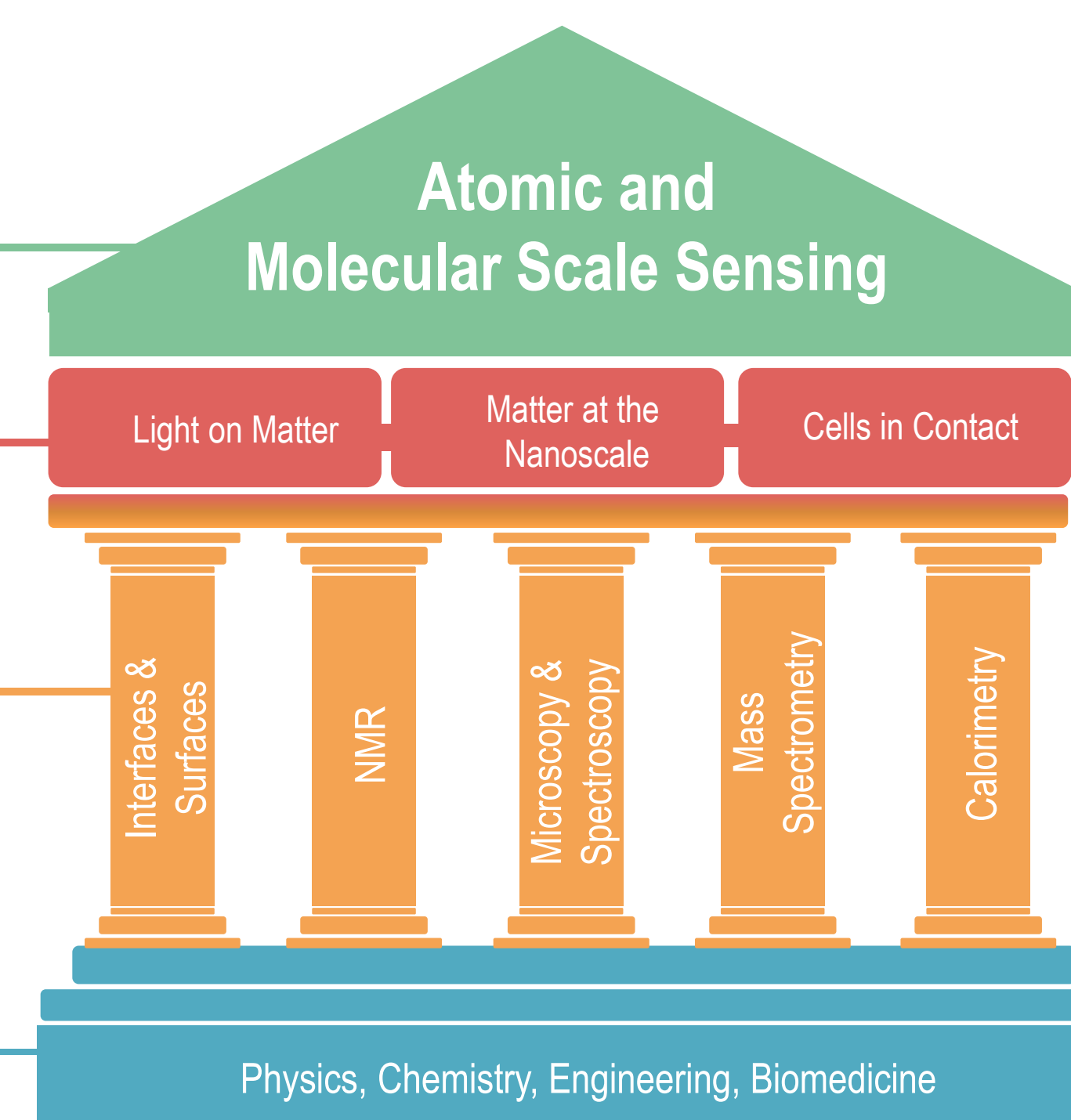
Cells as sensors for molecules, nanoobjects and light landscapes

Vision

Topics

Enabling technologies

Disciplines



Light on Matter

Excitons in low dimensional systems

- Guided excitons in nanoparticles-molecule aggregate architectures
- Design of exciton properties using 2D heterostructures and nanoparticles
- Electronic dynamics in molecular layers from high harmonic spectroscopy
- Exciton mobilities and dynamics from time-resolved spectroscopy

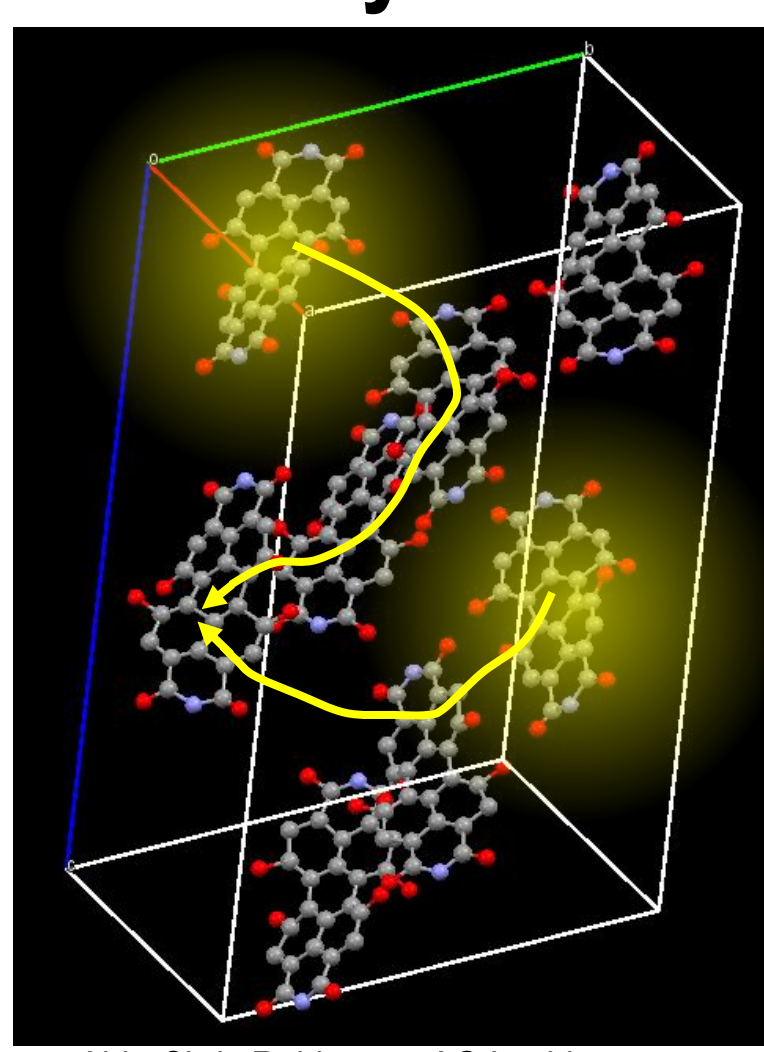


Abb. Chris Rehmann, AG Lochbrunner

Matter at the Nanoscale

Microstructuring with ultrashort pulses

- Machining of thermally sensitive materials (e.g. stents, polymers)
- Ultrashort laser pulse-based surface functionalization of tribological pairing in endoprotheses
- Microscopic processes in laser machining and laser plasmas

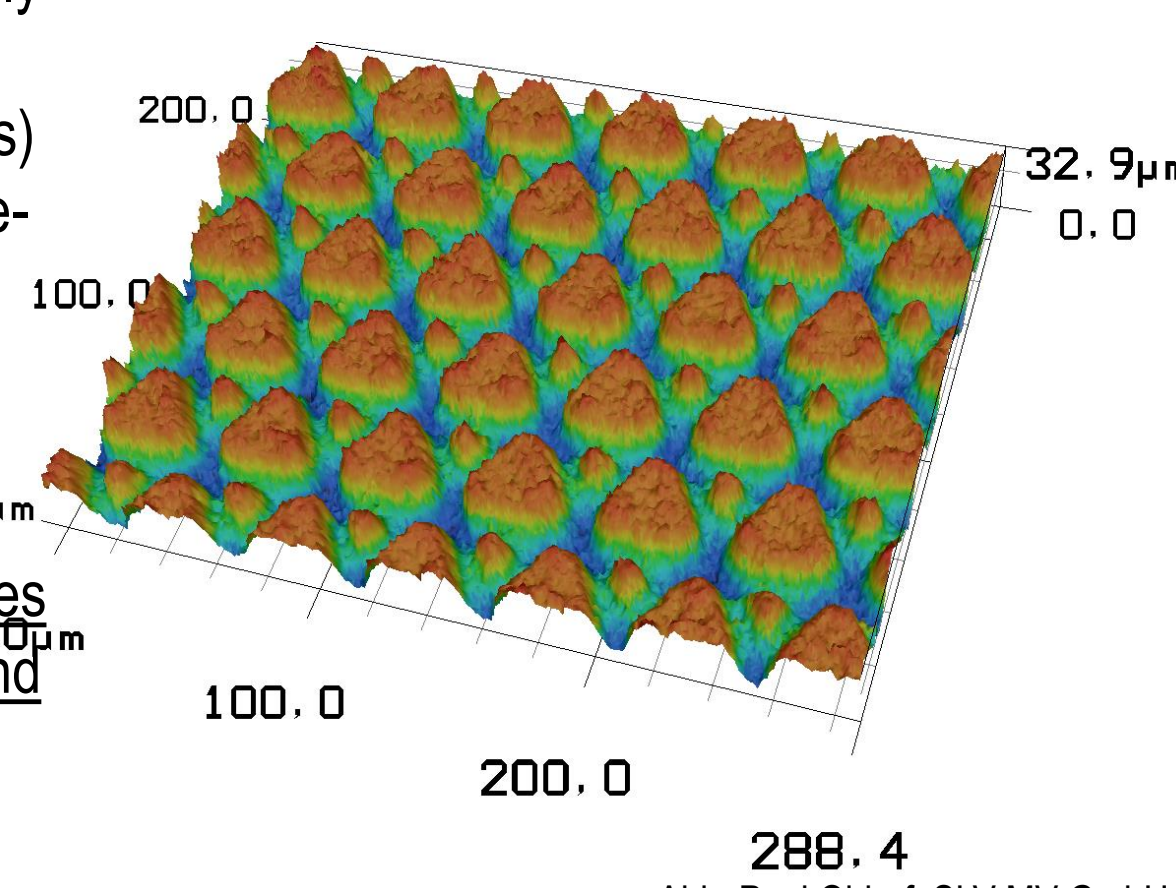


Abb. Paul Oldorf, SLV MV GmbH

Cells in Contact

Electric and Optical Signals

- Pacemaker cell / tissue for therapy and assessment
- Cardiomyocytes for monitoring and sensing
- Electric and mechanical stimulation for differentiation of cells and tissues
- Photoconversion and optogenetics

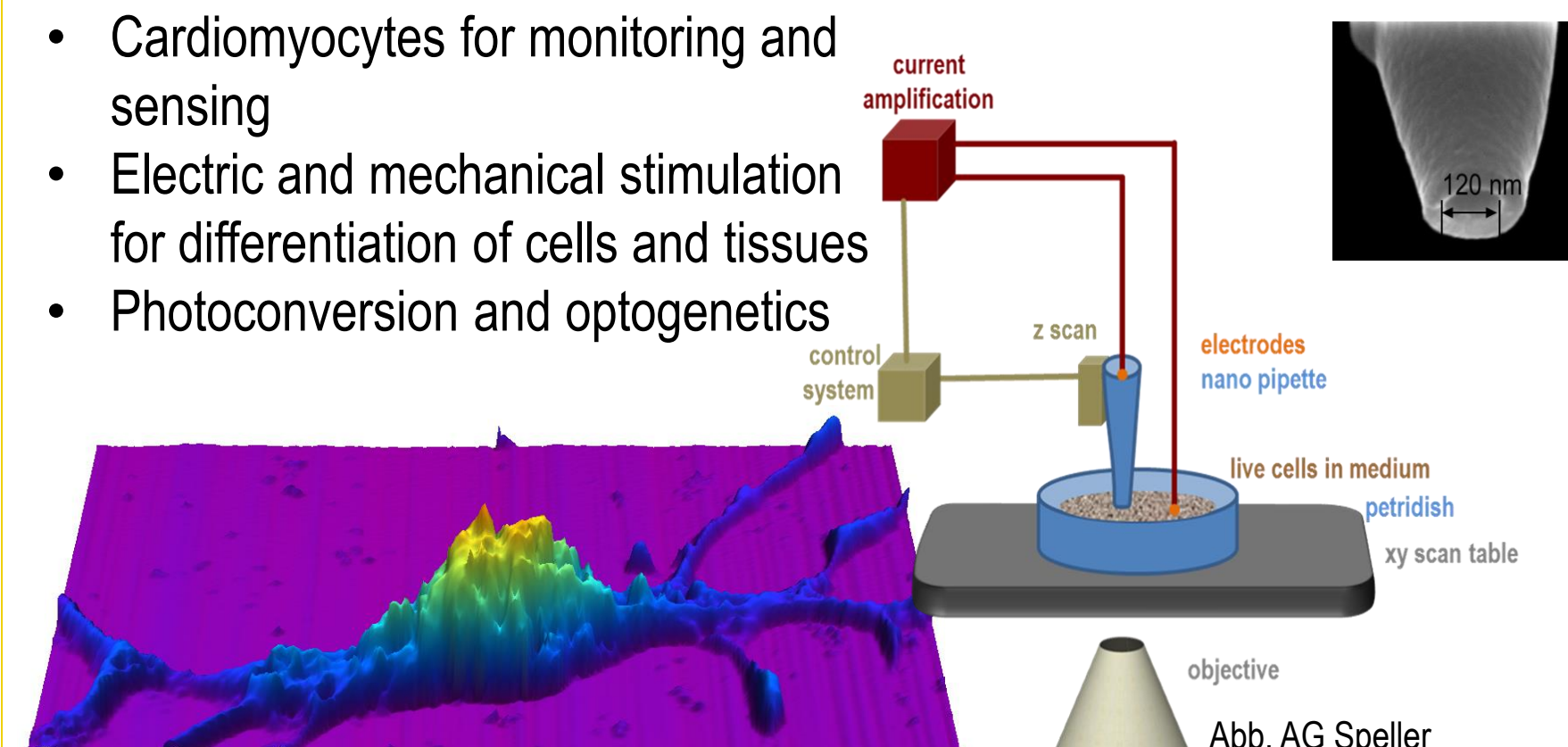
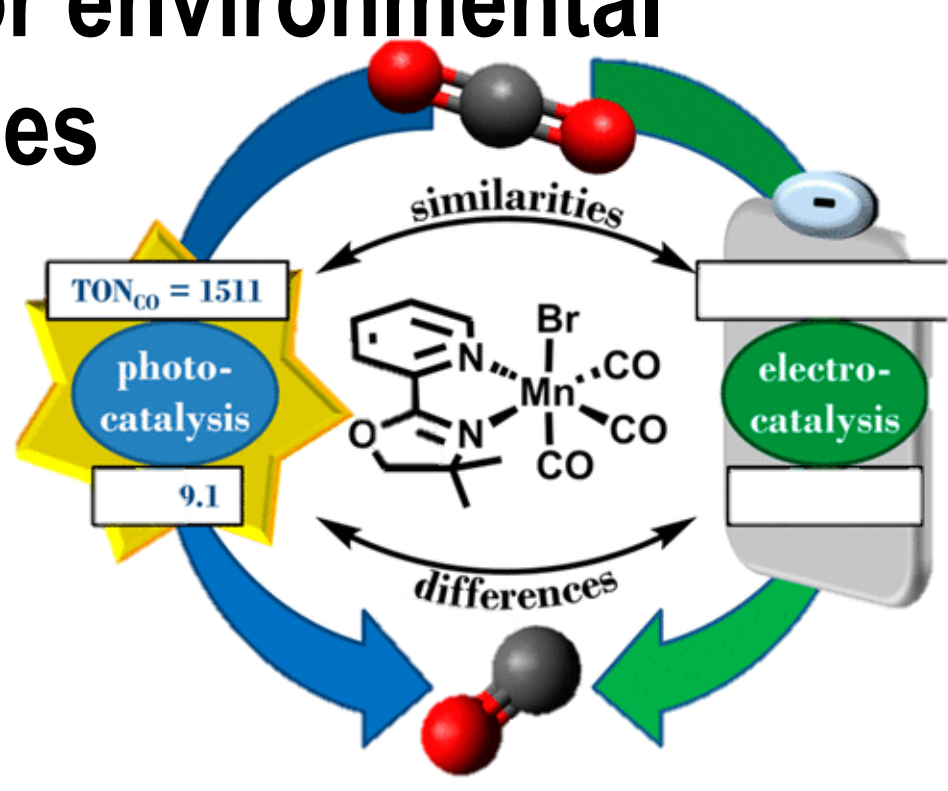


Abb. AG Speller

Photoprocesses for environmental friendly technologies

- Metal complexes as photosensitizers
- Photocatalysis for solar fuels
- Controlling the photoionization of complex molecular systems for mass spectrometry



ACS Catal. 2019, 9, 3, 2091-2100

Chemically structured surfaces and membranes

- Morphology, composition and toxicity of exhaust particles from combusted marine diesel
- Efficient particle filters and gas scrubbers for marine diesel exhaust gases
- Dispensing technology for filter membrane assembly

Nanoparticles-cell Interaction

- Uptake of nanoparticles in organelles and cells
- Influence of nanoparticles surface and chemistry on cellular reactions
- Cells as sensors for nanoparticles

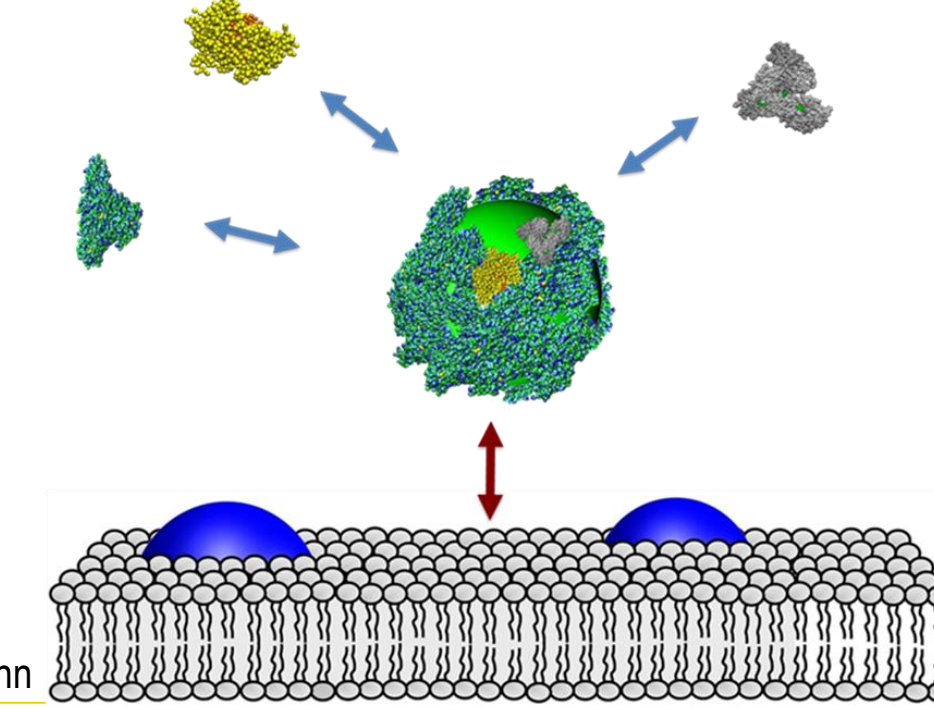


Abb. AG Zimmermann

Imaging

- Imaging of biological structures by nonlinear optics and Förster energy transfer
- Diffractive imaging and microscopy with high harmonics
- Imaging EELS (electron energy loss spectroscopy) with the new STEM

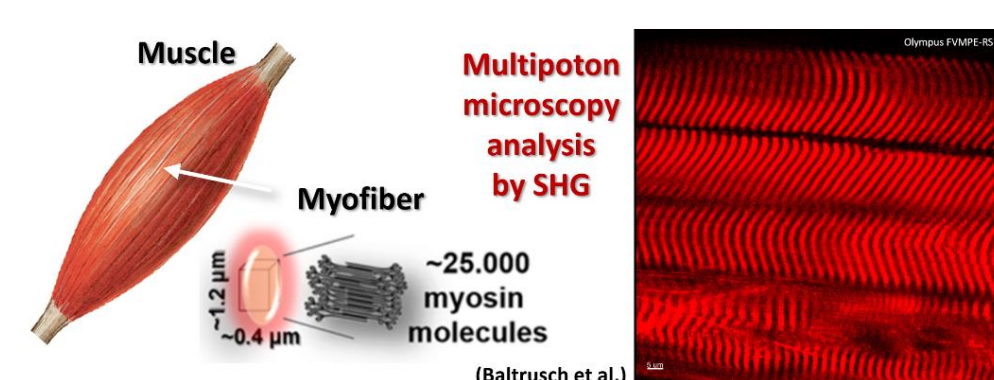


Abb. AG Baltrusch

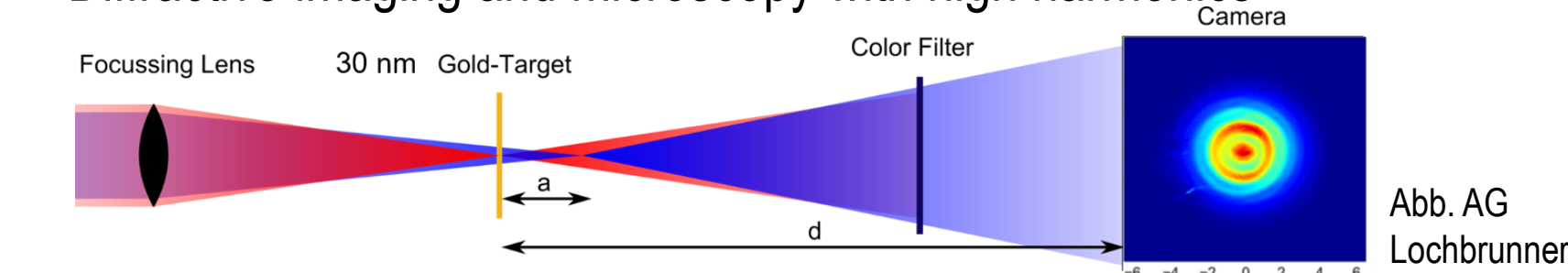


Abb. AG Lochbrunner

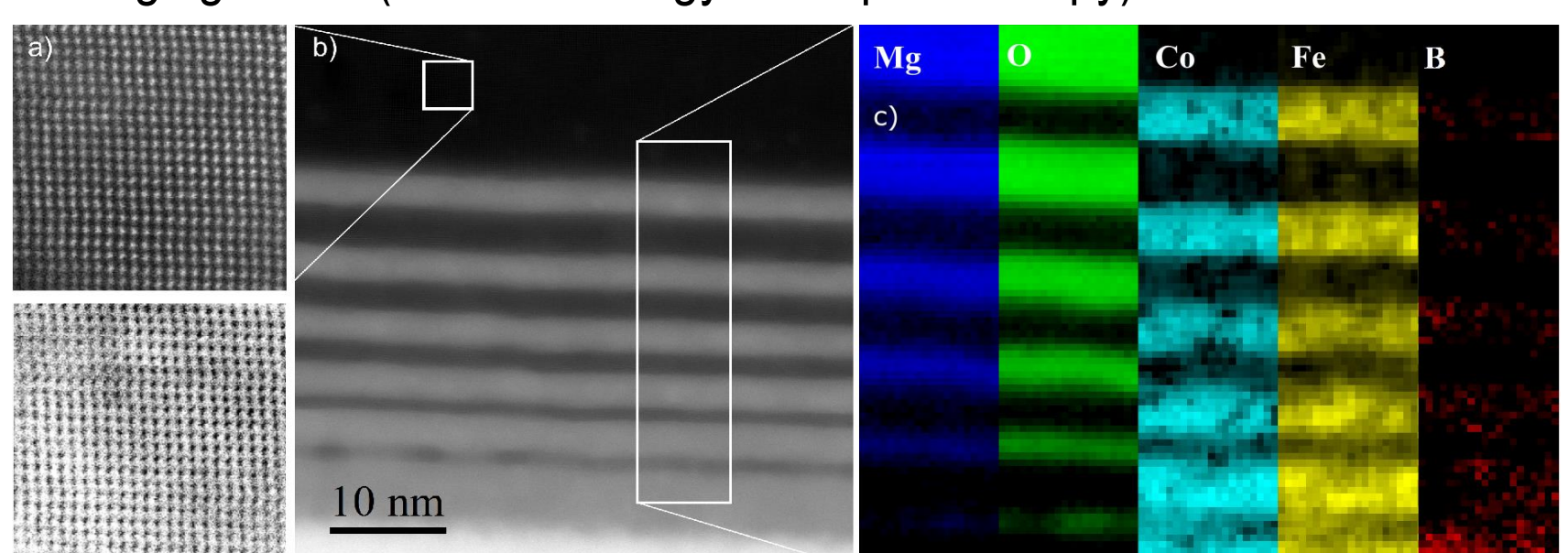


Abb. ELMI-MV: High resolution STEM images (a,b) and EELS element mapping (c) of a model layer system with several interfaces (sample from Prof. Michael Seibt, University of Göttingen)

Electronic properties of nanostructures

- Functional and chemically protected transition metal cluster films as transistors and sensors
- Low-dimensional optoelectronic materials exploiting quantum effects for new device types

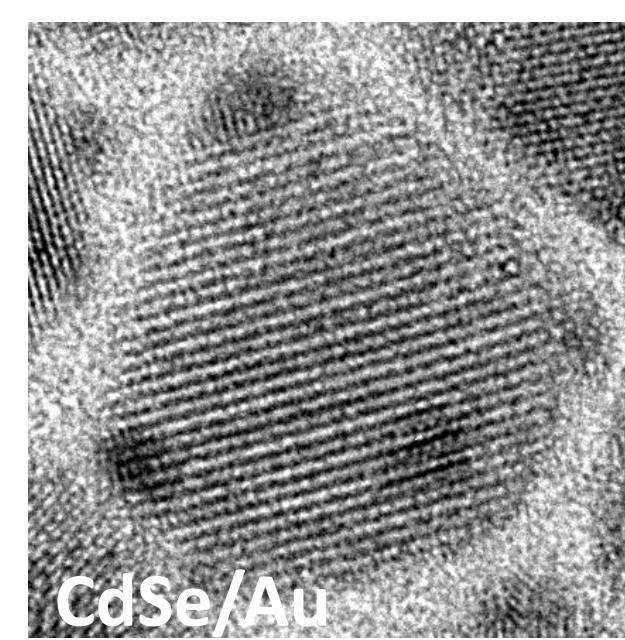


Abb. AG Klinke, ELMI-MV

Nanodesign of bulk materials

- In-situ sensing of phase transformations in materials → designing
- micro-/nano-structures
- Additive manufacturing and design of micro-structures
- Molecular design of renewable fuels

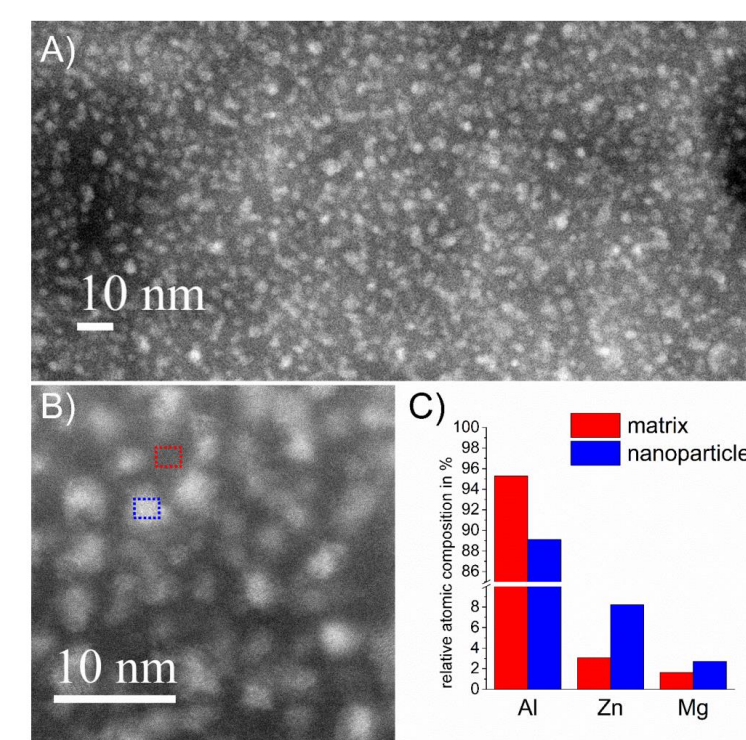


Abb. AG Kessler, ELMI-MV: HAADF-STEM images (a,b) and EDX element analysis (c) of an AlMgZn alloy showing a high density of small precipitations with an enhanced amount of Zn and Mg *

Designed Surfaces

- Interaction of cells with structured Titanium surfaces
- Drug-delivery systems with drug depots on implant surfaces

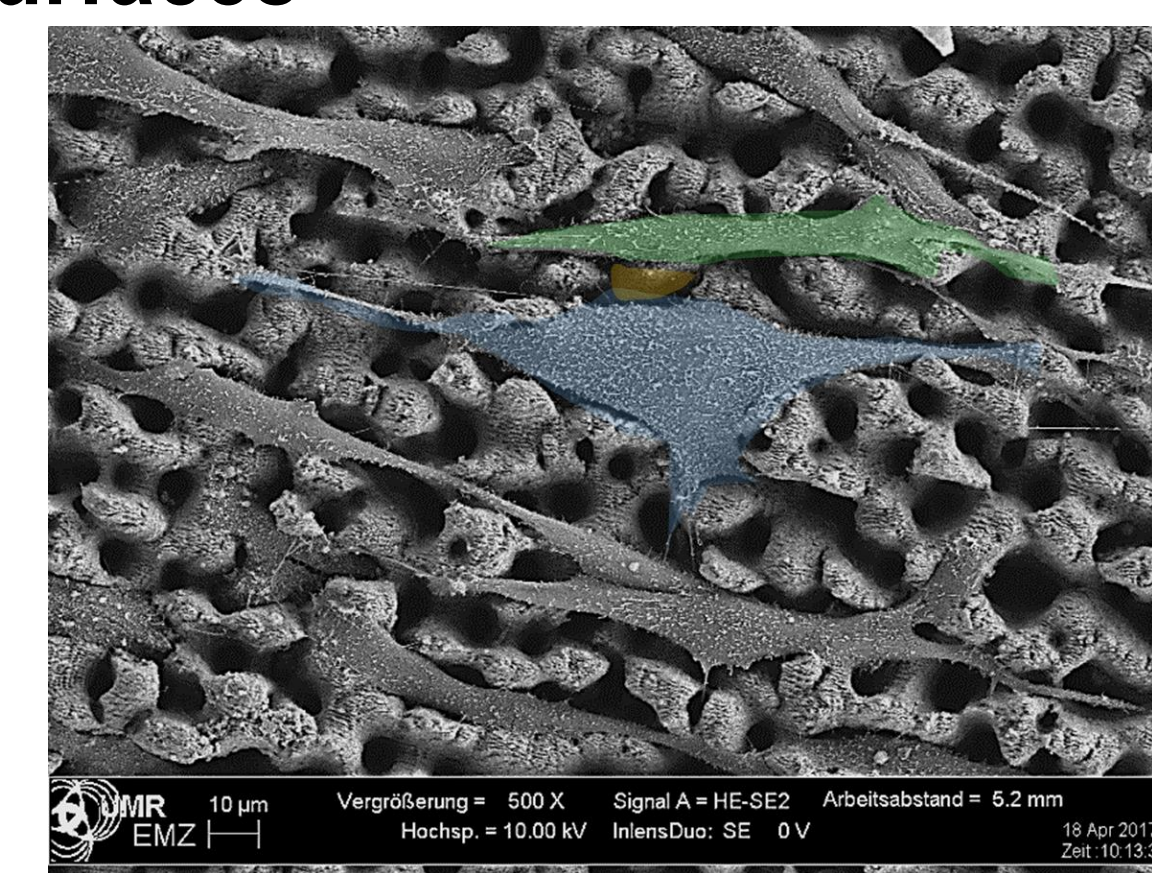


Abb. AG Nebe, EMZ, SLV: MG-63 osteoblasts on UKP-structured titanium

Molecular Processes

- Biomolecular recognition by means of dynamic nuclear polarization (DNP)-NMR
- Bio-catalysis
- Mitochondrial activity and dynamics
- Cell-cell contacts and cell adhesion on material surfaces