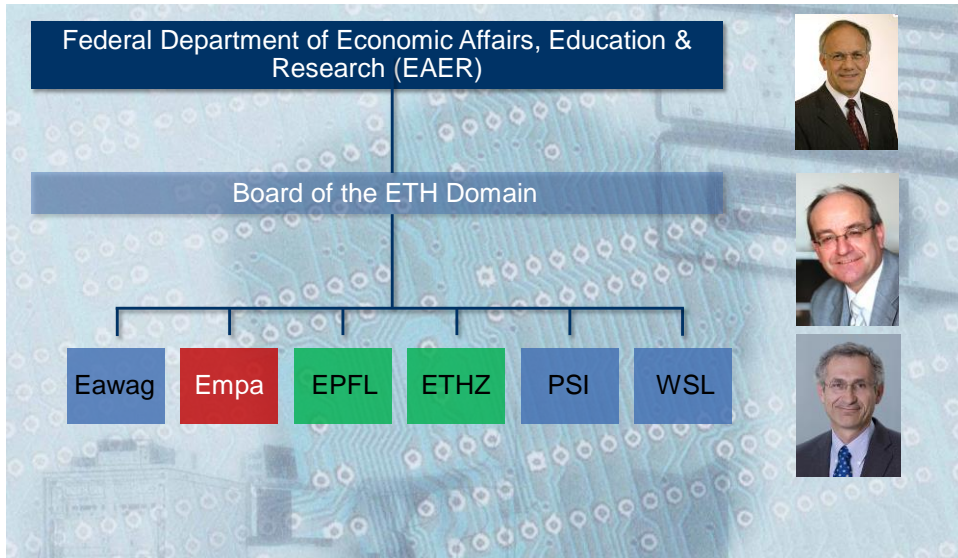




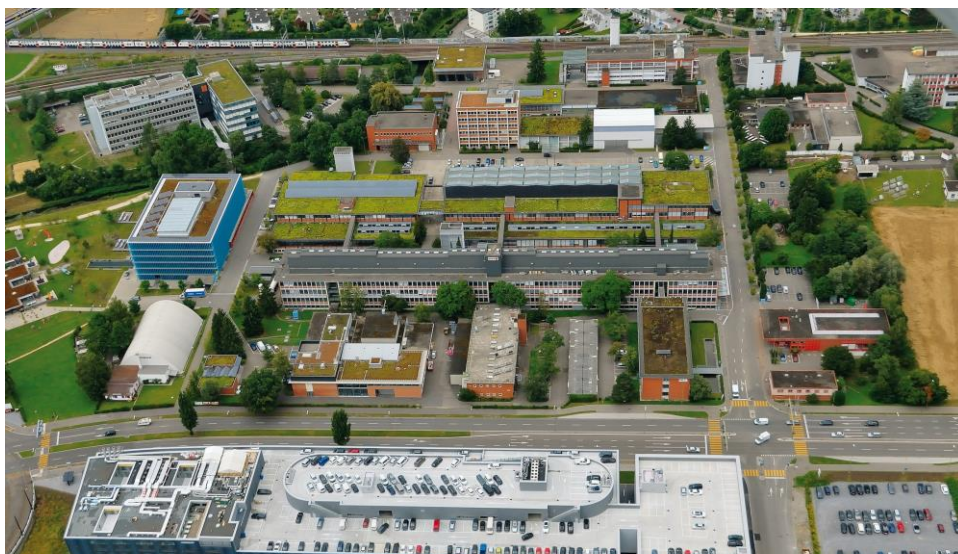
St. Gallen, Stiftsbibliothek, Cod. Sang. 602

Papier · 522 pp. ·
Gallen · 1451-1460





Empa-Eawag-Campus Dübendorf



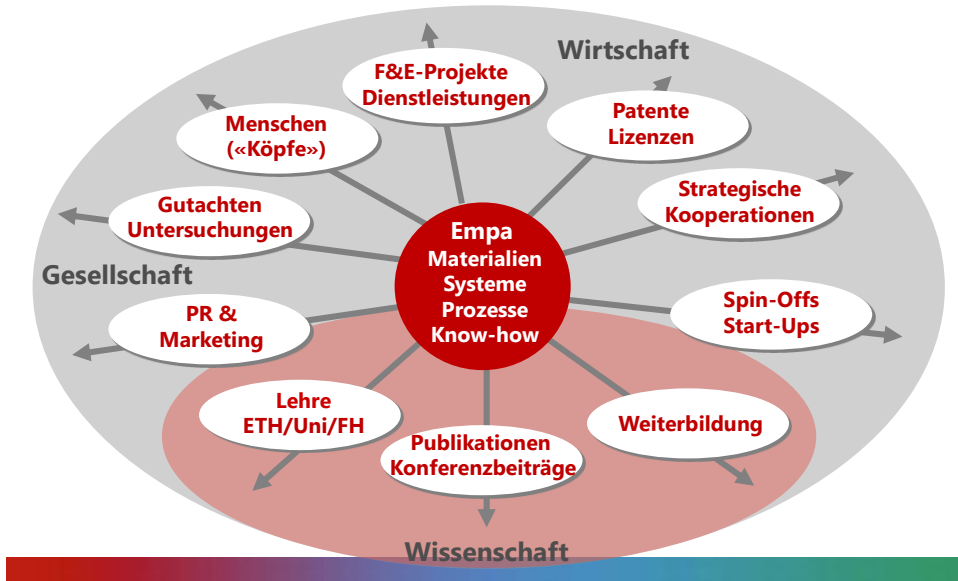
Empa-Standort St.Gallen



Empa-Standort Thun



Integrierter Wissens- & Technologietransfer «From Science to Business»



Empa – at a glance

3 Sites

Dübendorf, St. Gallen, Thun
~ 30 Technical Laboratories,
more term. than regular empl.

~1000 Employees (~830 FTE, 28% female)

28 Professors

~200 PhD students, 120 Post Docs

~200 graduates and trainees



Empa - the place where innovation starts

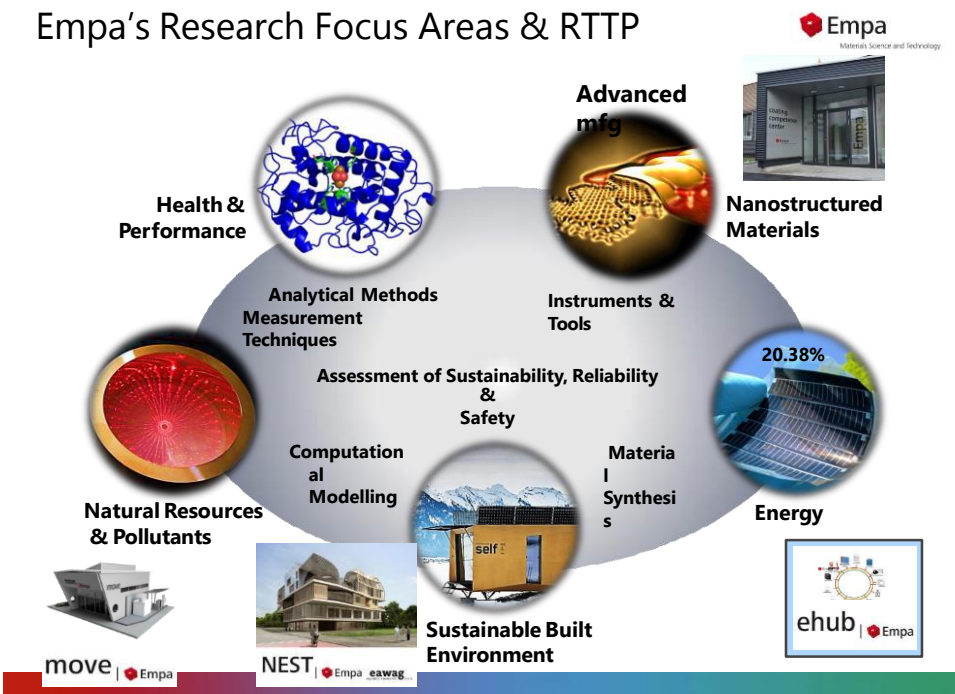
Unsere Vision

“Materialien und Technologien für eine nachhaltige Zukunft”

“...Gemeinsam mit unseren Partnern aus der Forschung, **Industrie und dem **öffentlichen Sektor**, setzen wir alles daran, zur Sicherung unserer Zukunft die **Grenzen von Wissenschaft und Technik** immer wieder aufs Neue zu **erweitern**”**

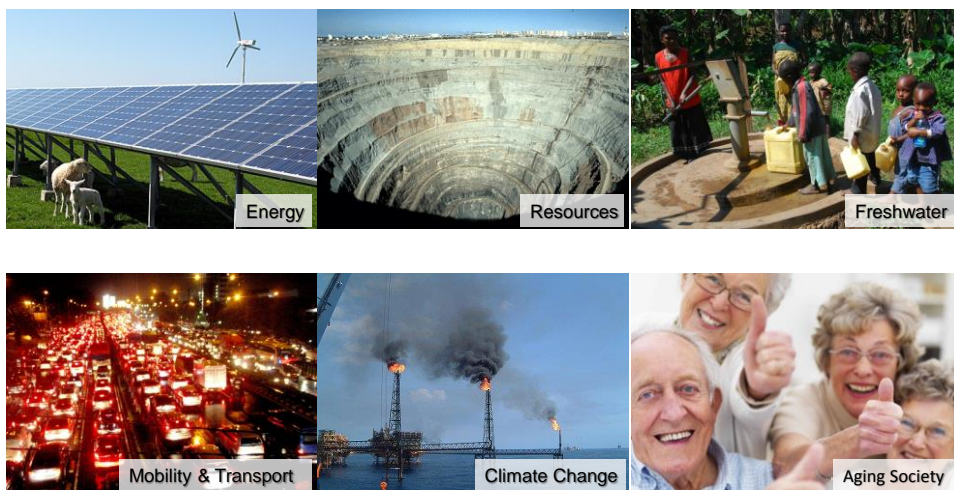
Auszug aus dem Empa Leitbild

Empa's Research Focus Areas & RTTP

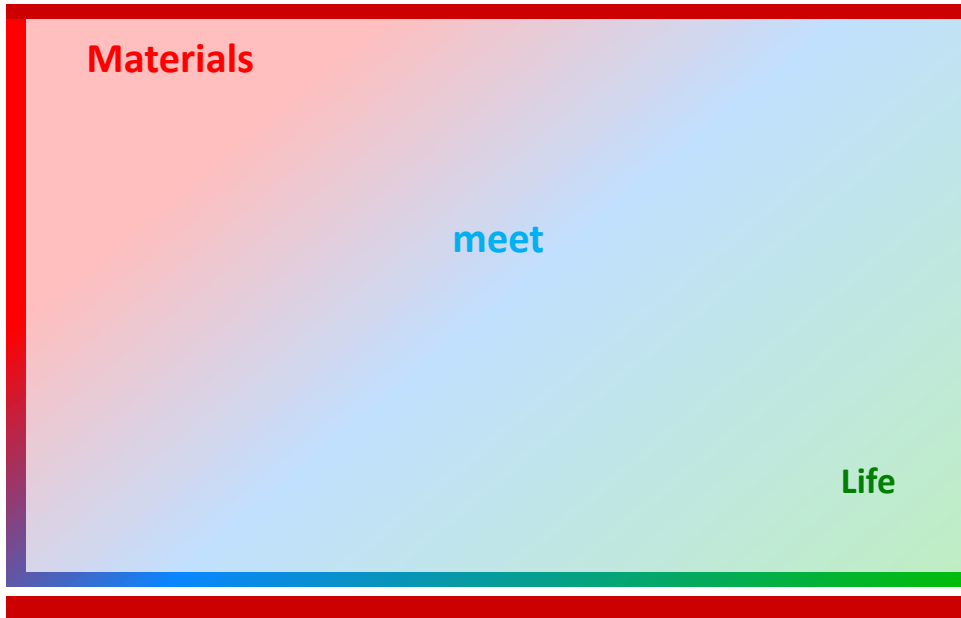




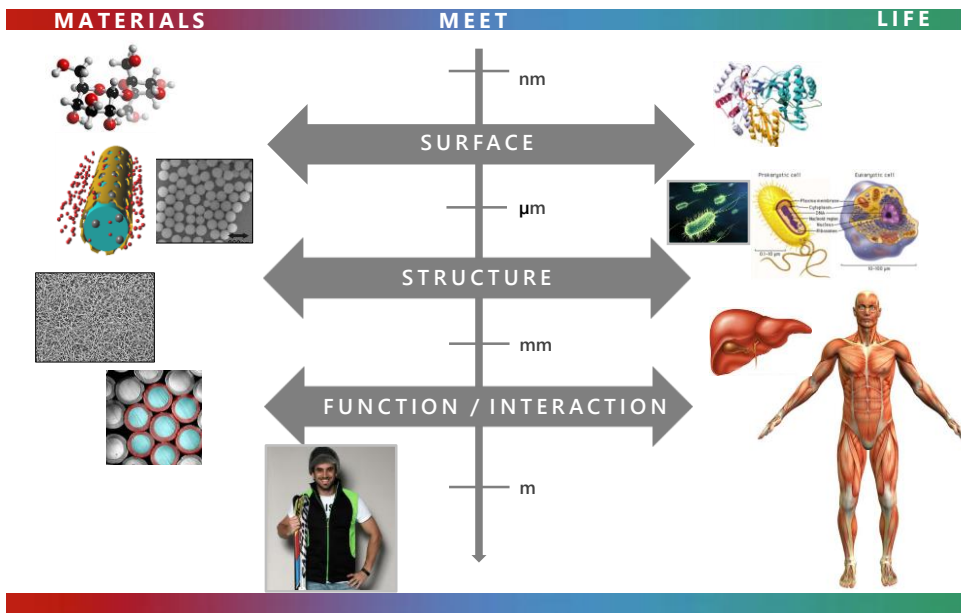
Global Challenges



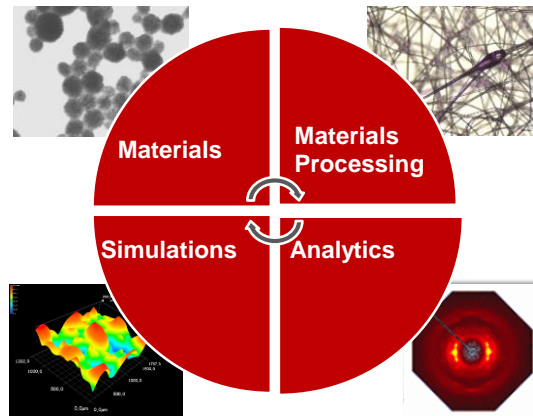
... also for material science



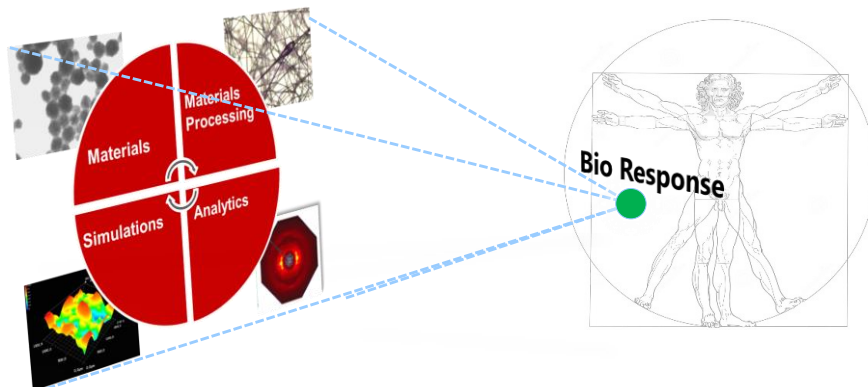
Materials meet life

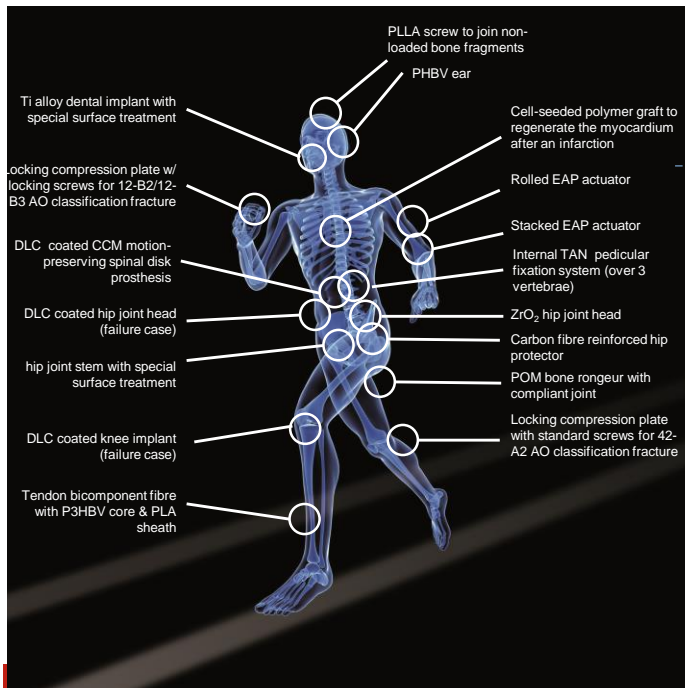


Accelerated Progress by sharing know how



Health & Performance

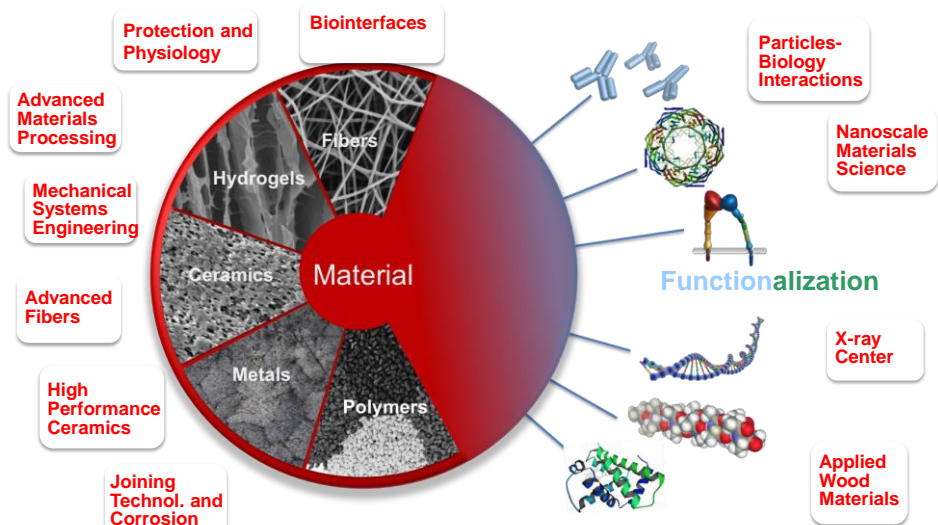




MedTech

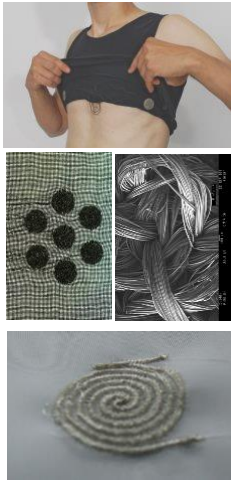
Combining the expertise of more than 10 Empa laboratories

From Materials to Biointerfaces



Smart textiles for protective clothing, sports apparel and medical textiles

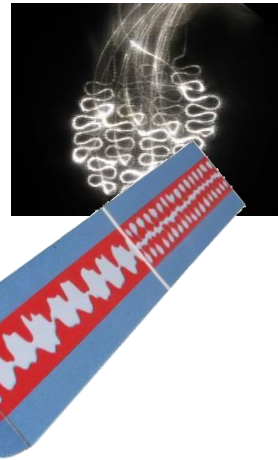
■ electrodes



■ optical sensors



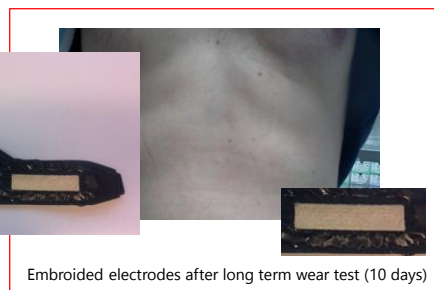
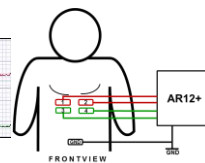
■ new fibre materials



manfred.heuberger@empa.ch

Long-term ECG measurements

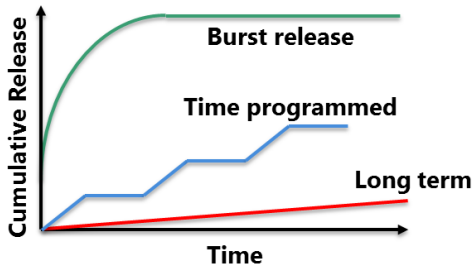
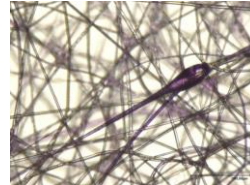
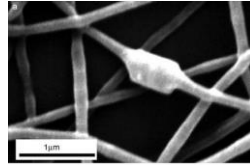
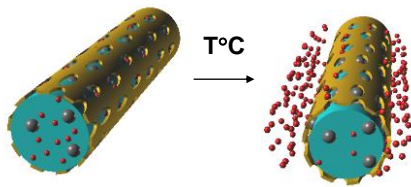
Signal comparison: **textile electrode** x **gel electrode** (ca. 13s)



Weder et al. *Sensors*, 2015, 15, 1750

rene.rossi@empa.ch

Self-care materials



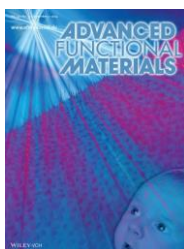
SWISS TEXTILES

armasuisse
Zentrum für textile und textile Systeme
Centre pour systèmes textiles et tissu
Centro per i sistemi misti a c.a.à
Center for Military and Civilian Systems

15 Industrie-partner

rene.rossi@empa.ch

Medikamenten-Abgabe durch schaltbare Polymere



Materials Science & Technology,
Materials Science & Technology
Materials Science & Technology
Materials Science & Technology
Materials Science & Technology
EMPA
Light-responsive membrane

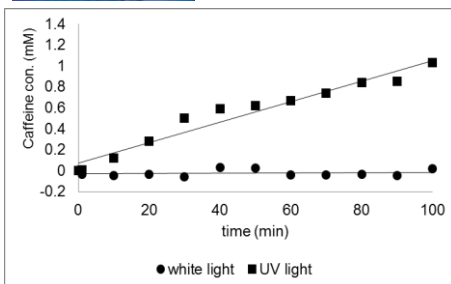
Pflaster statt Spritzen für Frühchen und Diabetiker



DÜBENDORF: Anstelle von schmerzhaften Spritzen könnten künftig Pflaster zum Einsatz kommen. In diese werden Medikamente integriert, die der Patient über die Haut aufnimmt. Dafür haben Forschende der Empa eine spezielle Membran entwickelt. Diese lässt Wirkstoffe durch, sobald sie mit UV-Licht bestrahlt wird. Während dieser Zeit erhält der Patient eine gleichmässige Dosierung des Medikaments. Die Membran lässt sich aber auch verschliessen, indem sie mit sogenanntem Weisslicht bestrahlt wird.



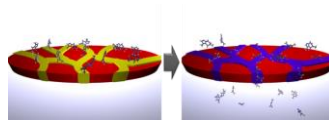
Frühchen wie dieses sollten bald weniger Schmerzen leiden, wenn man die Spritzen durch Pflaster, erspart das den Frühchen Schmerz und Stress», sagt Empa-Forscher Luciano Bossel. Eine weitere Anwendung sieht er beispielsweise bei Diabetes-Patienten. Diese müssen sich heute regelmässig Insulin spritzen. In Zukunft könnten sie sich das Medikament verabreichen, indem sie ein Insulin-Pflaster mit einer tragbaren Lampe aktivieren. **nw**



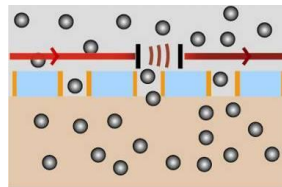
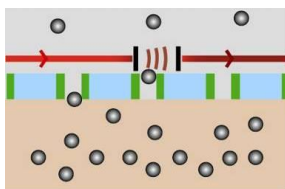
UniversityHospital Zurich

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Intelligenter Glukosesensor

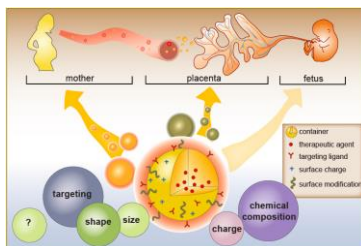


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Materials Science & Technology
Light-responsive membrane



rene.rossi@empa.ch

Nanomaterials at human placenta barrier



human placenta perfusion model
Wick et al 2010; Bürki-Thurnherr et al 2012;
Grafmüller et al 2013

Aim:

- Achieve a better understanding of NP-placenta interaction throughout pregnancy
- Provide a versatile and predictive placenta models that covers the entire gestational period as well as different potential uptake routes

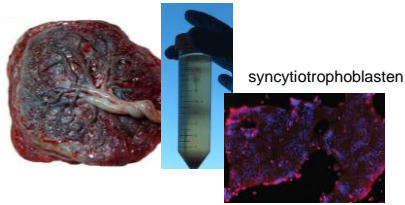
In collaboration with:

- Frauenklinik KSSG
Prof. Dr. R. Hornung
- Institut für Pathologie KSSG
Prof. Dr. W. Jochum
- Institut für Immunbiologie KSSG
Prof. Dr. B. Ludewig
- Hirslandenklinik Stephanshorn

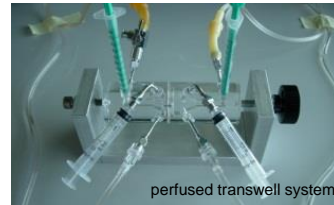
peter.wick@empa.ch

Advanced human *in vitro* models

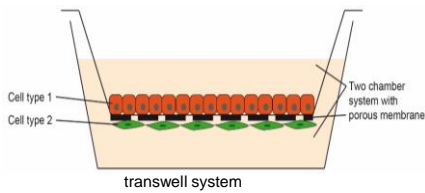
- cell line → primary cells



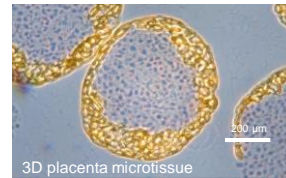
- static → perfused



- monoculture → co-cultures



- 2 dimensional culture → 3D culture



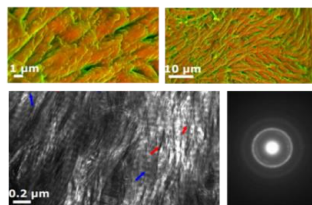
Reviewed in Wick P, Grafmüller S, Fink A, Rothen-Rutishauser B, MRS Bulletin Nov Issue 2014

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Soft Tissue Mineralization

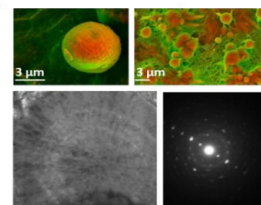


Biomaterial found in Bone



poorly crystalline apatite

Biomaterial found in Aortic Tissues



highly crystalline Mg-containing apatite

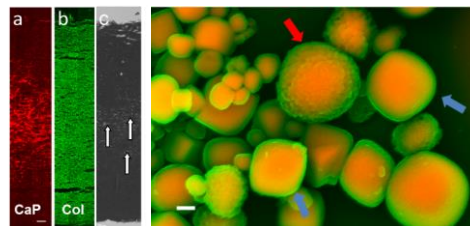
- Artherosclerosis
- Alzheimer's
- Cancer
- Placental calcification



Inge K. Herrmann



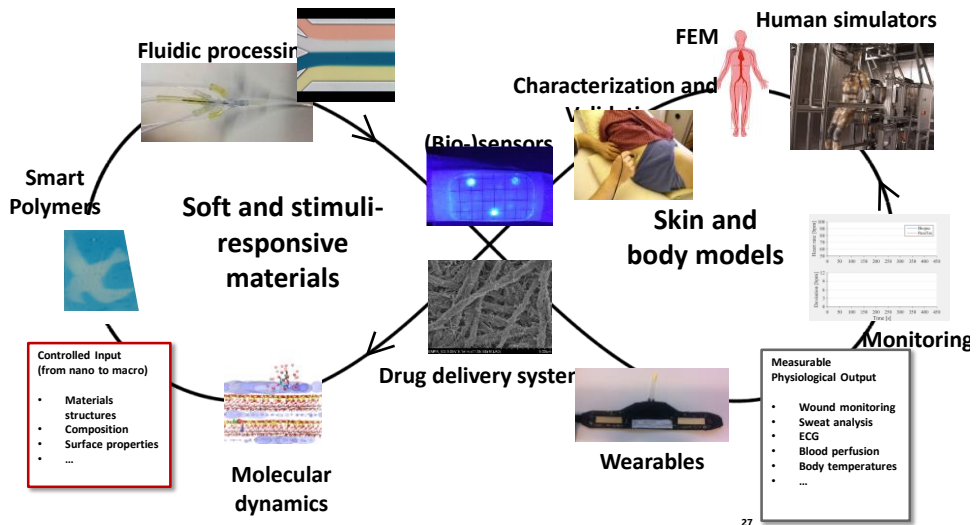
Sergio Bertazzo



peter.wick@empa.ch

BioMemTex - Biomimetic Membranes and Textiles

From the control of intermolecular interactions to smart functions:
a bridge from soft material structures to personalized body performance



Empa
Materials Science and Technology

ETH zürich

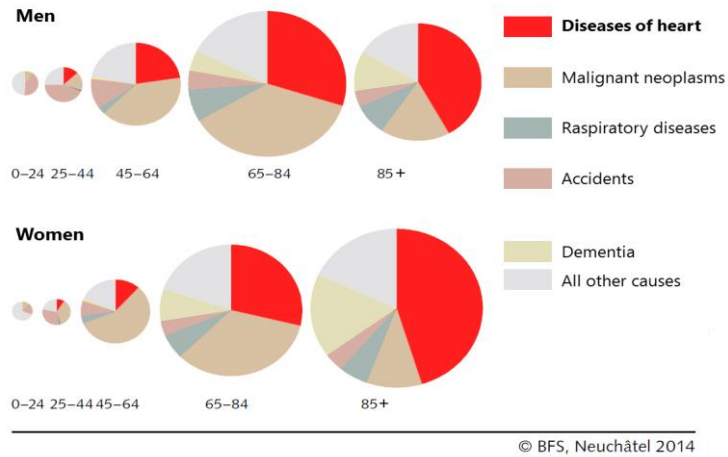
Zurich Heart

Cell encapsulation –
Enabling technologies for in situ cell delivery for a multilayer hybrid membrane

Lukas Weidenbacher, Afshin Abrishamkar, Markus Rottmar, Anne Géraldine Guex, Katharina Maniura, René Rossi, Stephen Ferguson, Giuseppino Fortunato

Heart disease: impact on society

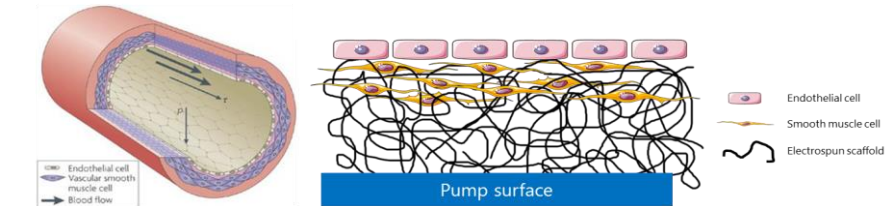
Still number 1 cause of death
(Statistics for Switzerland in 2012)



Envisioned solution – biomimetic pump surface

Problem: Lack of blood compatibility

Idea: Mimicking the native blood interface



C. Hahn et al. – Nature Reviews, 2009

Create natural environment for endothelial cells

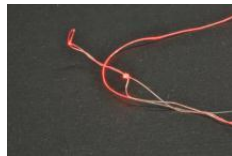
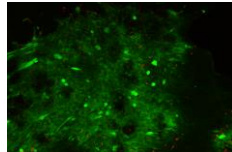
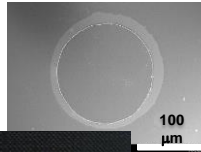
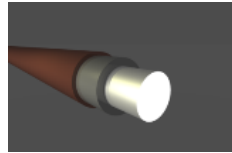
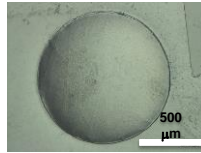
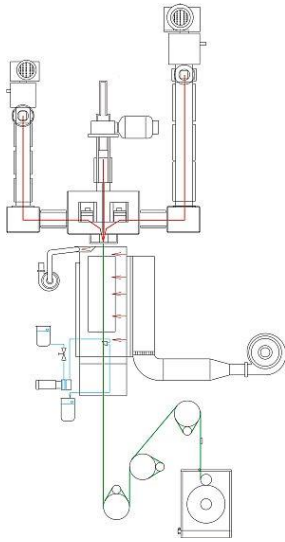
- Cell-matrix contact
- Cell-cell contact
- Chemokine signalling

→ Better attachment + functionality!

| Pathway | Primary Role | Signal Direction |
|--------------|----------------------------|------------------|
| PDGF-B/PDGFβ | Recruitment | EC → SMC |
| S1P | Recruitment | EC → SMC |
| TGF-β | Differentiation/maturation | EC → SMC |
| Notch | Differentiation/maturation | EC → SMC |
| Eph/ephrin | Differentiation/maturation | EC → SMC |
| Connexin | Differentiation/maturation | EC → SMC |
| Ang1/Tie2 | Stability/survival | EC ← SMC |

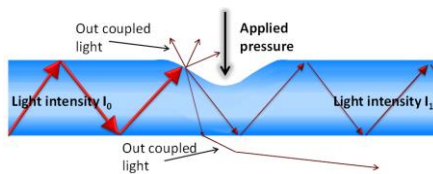
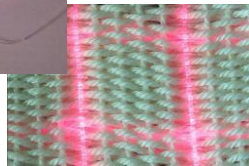
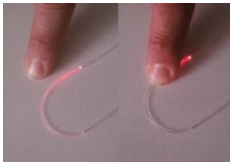
B. Lilly - Physiology, 2014

Flexible optische Fasern aus Polymeren

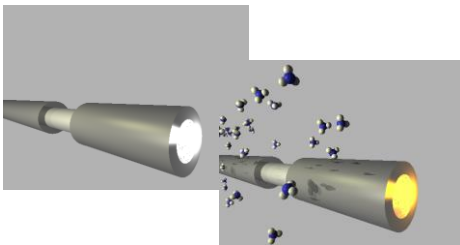
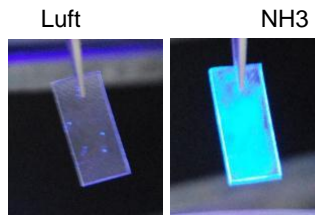


Reifler et al. *Polymer*, 2014, 55: 5695

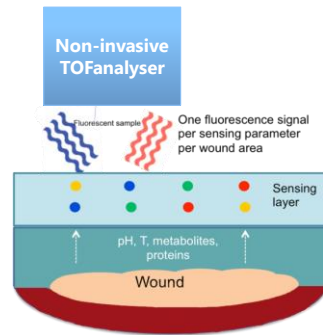
Präzise Druckmessungen



Chemische (Bio-)Sensoren



Sensing Wound PAD – Cross section

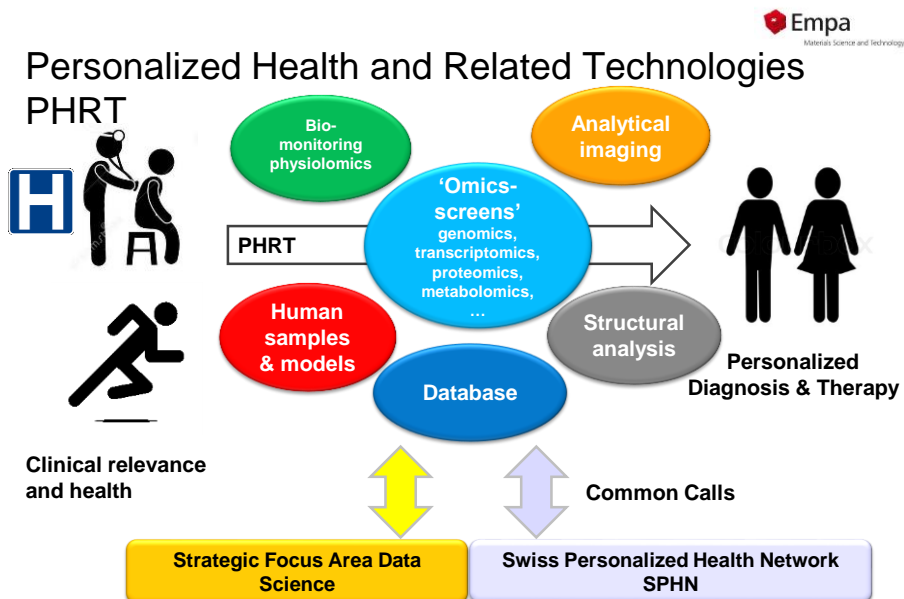


tiler EKG-Sensor für Langzeitmonitoring



Strategische Fokusbereiche in der Forschung 2017–2020

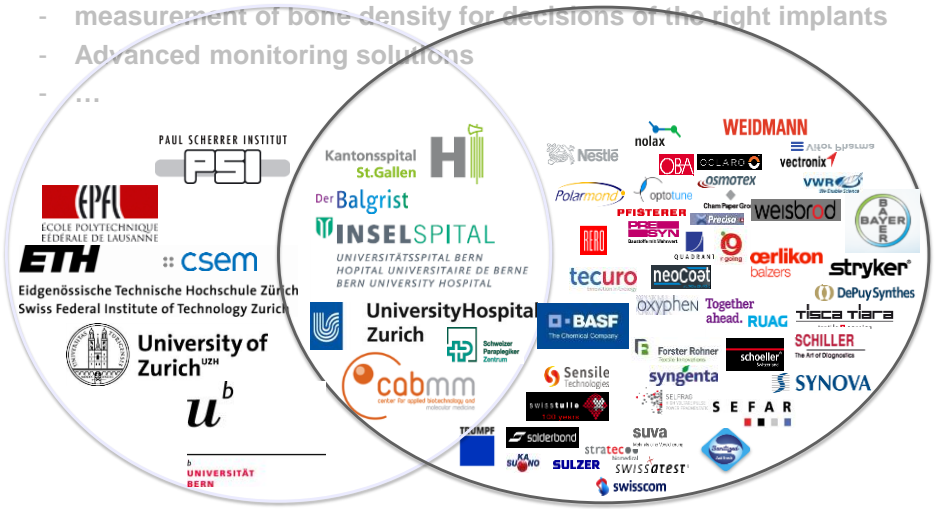
| | |
|---|----|
| Energie | 46 |
| Personalisierte Medizin und Medizintechnologien | 48 |
| Big Data und Digitale Wissenschaften | 50 |
| Fortgeschrittene Produktionsverfahren (Advanced Manufacturing) | 52 |



Intensified link with Academia, Industry and Hospitals

Supplying materials to clinicians:

- antibacterial surfaces for various catheter types
- measurement of bone density for decisions of the right implants
- Advanced monitoring solutions
- ...



Acknowledgements:



Kantonsspital
St.Gallen

INSELSPITAL
UNIVERSITÄTSSPITAL BERN
HOPITAL UNIVERSITAIRE DE BERNE
BERN UNIVERSITY HOSPITAL

KTI/CTI
DIE FÖRDERAGENTUR FÜR INNOVATION
THE INNOVATION PROMOTION AGENCY

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