Bioscience Business & Health Forum

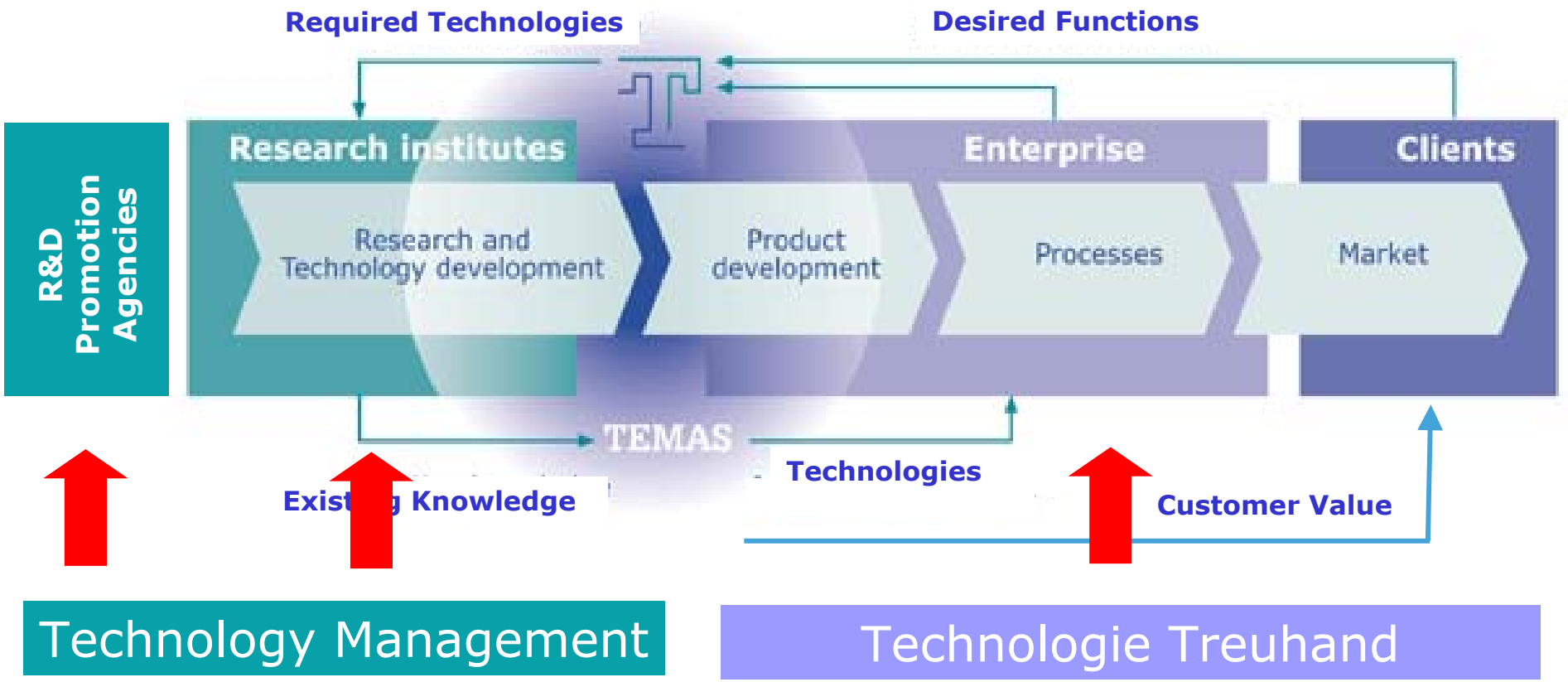
NanoMedicine and NanoBio in Switzerland

Karl Höhener
TEMAS AG

Topics

1. TEMAS's work and business model
2. Examples of Swiss companies and research institutions with biomedical applications of Nanotech
3. Limitations of Nanotech in healthcare
4. Current challenges and barriers
5. Swiss leadership in Nanotech
6. What will Nanomedicine mean for Switzerland with its strong pharmaceuticals, medical and biotech sectors

Service provider along the innovation path



Technology Management

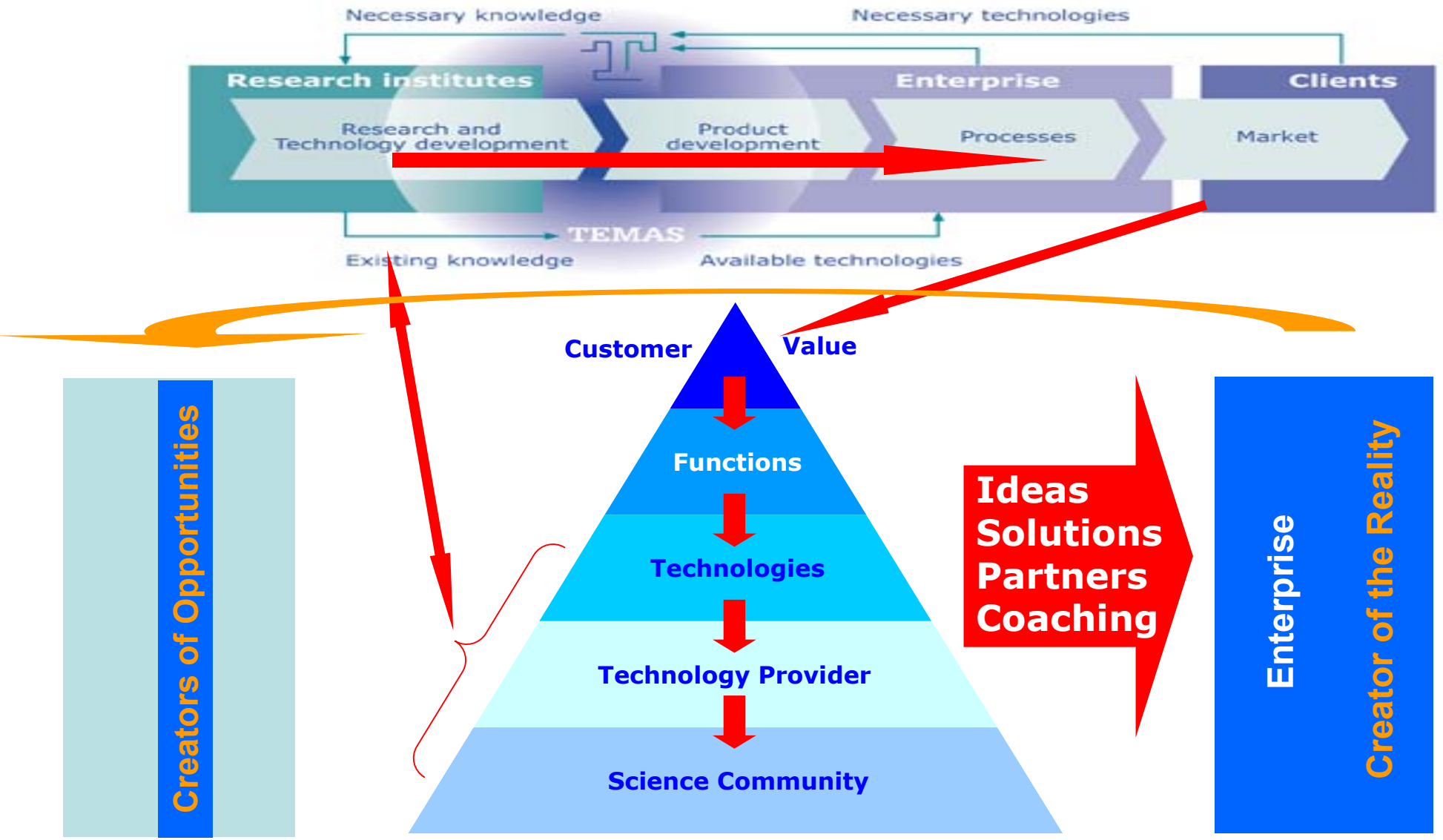
Technologie Treuhand

The two business units

TEMAS the Innovation Company

Business Model

TEMAS Technologie Treuhand



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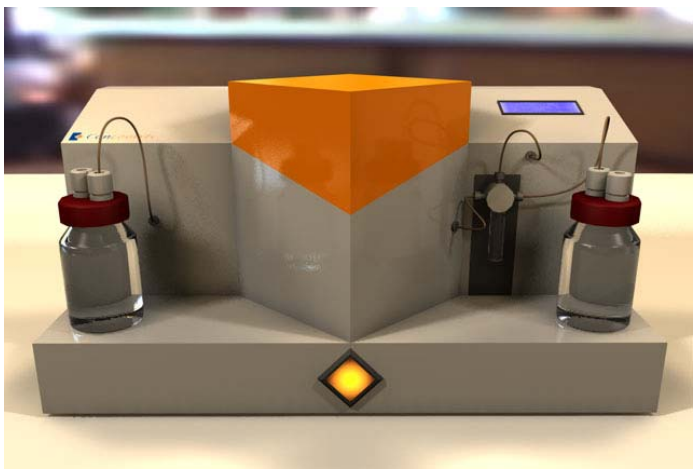
Cantilever sensor platform

designed for:

- ✓ industrial application
- ✓ development and scientific research

Research & Proof of Principle | Product Development | Prototyping | Market Introduction | Production



- ✓ Label-free biomolecular recognition with high sensitivity.
- ✓ Arrays with eight cantilevers allow multiplexed assays.
- ✓ Integrated temperature control and liquid handling allow reliable and reproducible measurements under well-defined conditions.
- ✓ Low-volume liquid cell allows analysis of small sample volumes.
- ✓ Innovative cantilever cartridge allows fast and easy sensor exchange.

Cantilever sensor platform

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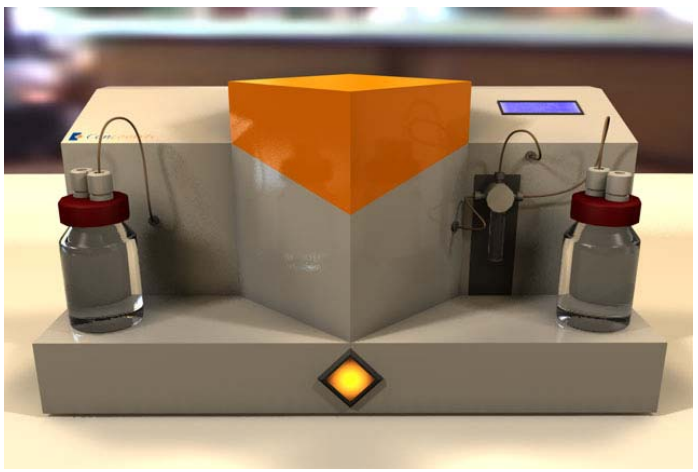
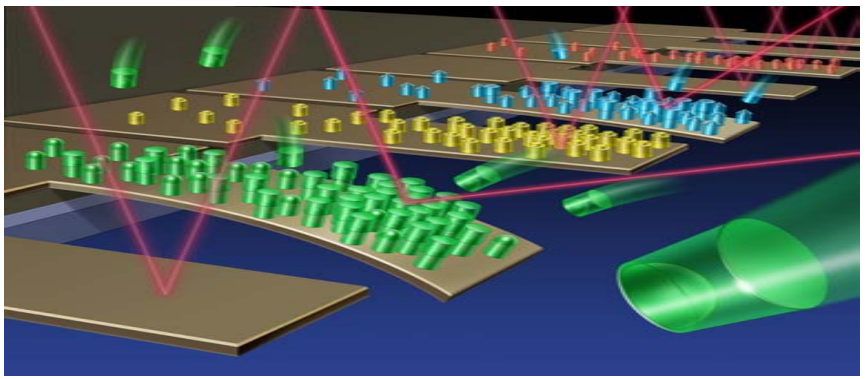


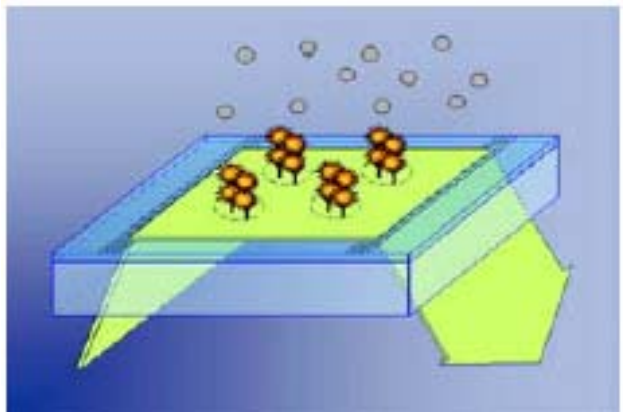
Research & Proof of Principle → Product Development → Prototyping → Market Introduction → Production



- Microfabricated silicon levers with a thickness of 1 to 10 µ
- Biochemical surface coating selectively binds specific target molecules.
- Adsorption of few molecules will create surface stress on the cantilever and result in tiny deflections of only a few nm

ZeptoMARK™ CeLyA is a complete microarray system for protein expression and activation profiling tailored to the needs of drug profiling laboratories and researchers working on profiling the proteome of cellular systems.

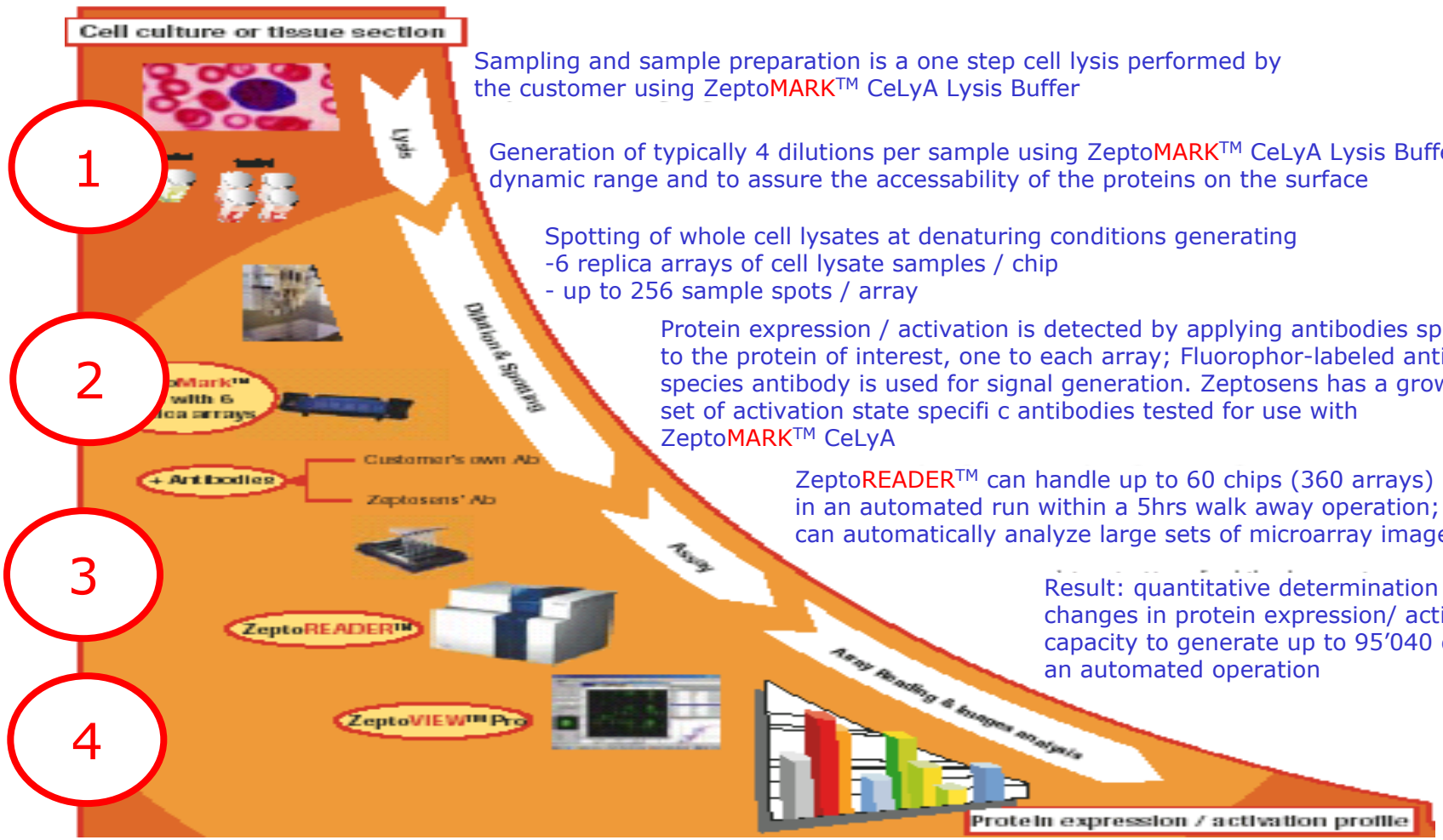
Research & Proof of Principle | Product Development | Prototyping | Market Introduction | Production



Planar Waveguide (PWG) technology
The PWG detection technology is applied in the ZeptoREADER to provide highest performance - sensitivity exceeds other fluorescence based microarray approaches by a factor of 50.

ZeptoMARK™ CeLyA

Research & Proof of Principle | Product Development | Prototyping | Market Introduction | Production



Sampling and sample preparation is a one step cell lysis performed by the customer using ZeptoMARK™ CeLyA Lysis Buffer

Generation of typically 4 dilutions per sample using ZeptoMARK™ CeLyA Lysis Buffer to expand the dynamic range and to assure the accessability of the proteins on the surface

Spotting of whole cell lysates at denaturing conditions generating
-6 replica arrays of cell lysate samples / chip
- up to 256 sample spots / array

Protein expression / activation is detected by applying antibodies specific to the protein of interest, one to each array; Fluorophor-labeled anti-species antibody is used for signal generation. Zeptosens has a growing set of activation state specifi c antibodies tested for use with ZeptoMARK™ CeLyA

ZeptoREADER™ can handle up to 60 chips (360 arrays) in an automated run within a 5hrs walk away operation; ZeptoVIEW™ can automatically analyze large sets of microarray images

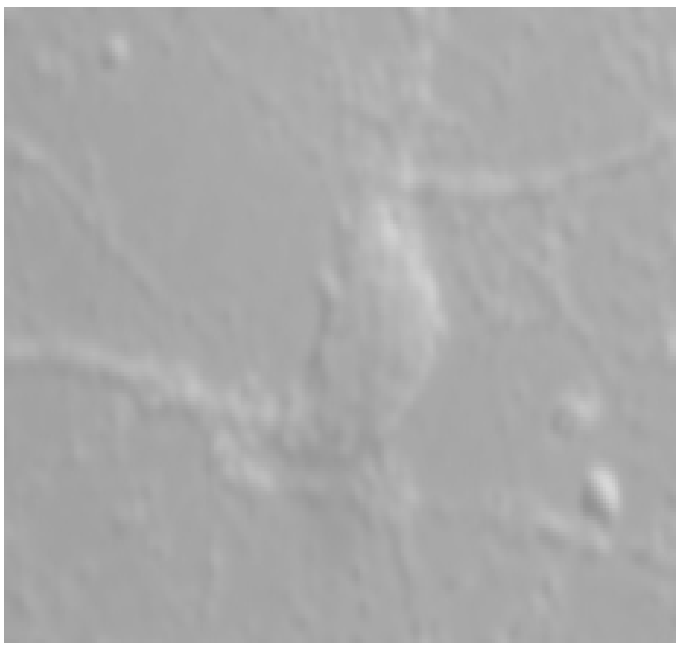
Result: quantitative determination of subtle changes in protein expression/ activation with a capacity to generate up to 95'040 data points in an automated operation

Digital Holography Microscopes (DHM)

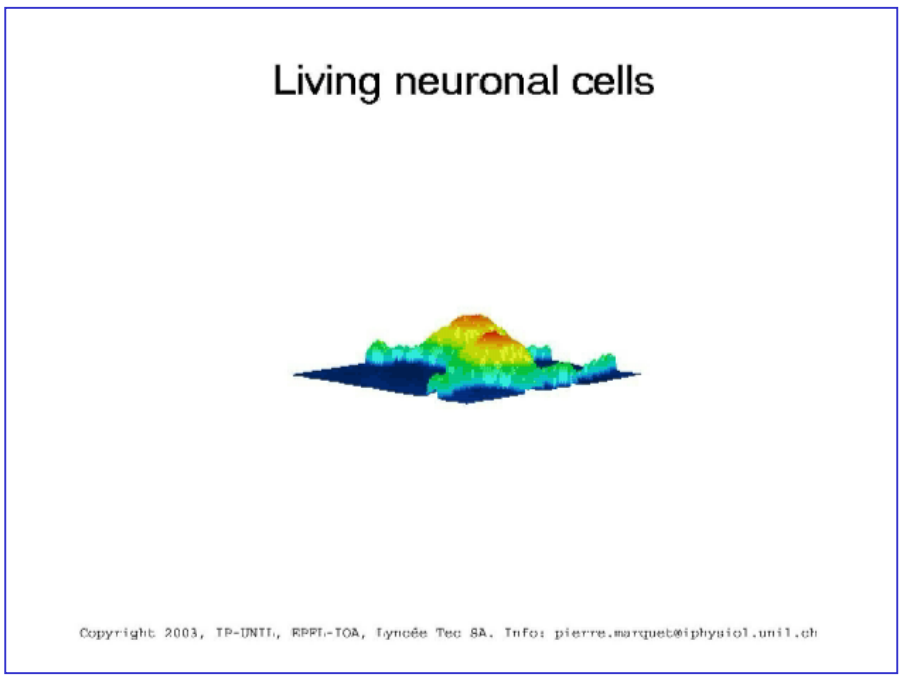
Research & Proof of Principle | Product Development | Prototyping | Market Introduction | Production

Cortical cells of mice observed by:

Conventional microscope



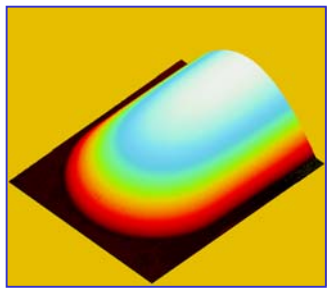
DHM



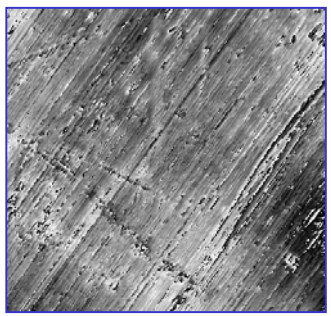
The first strictly non invasive, 3D and real time measurement system at the nanometer scale!

Digital Holography Microscopes (DHM)

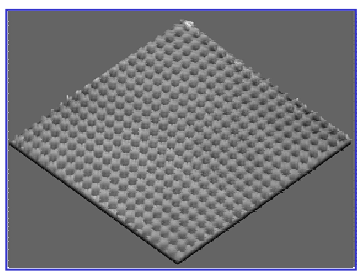
Material sciences



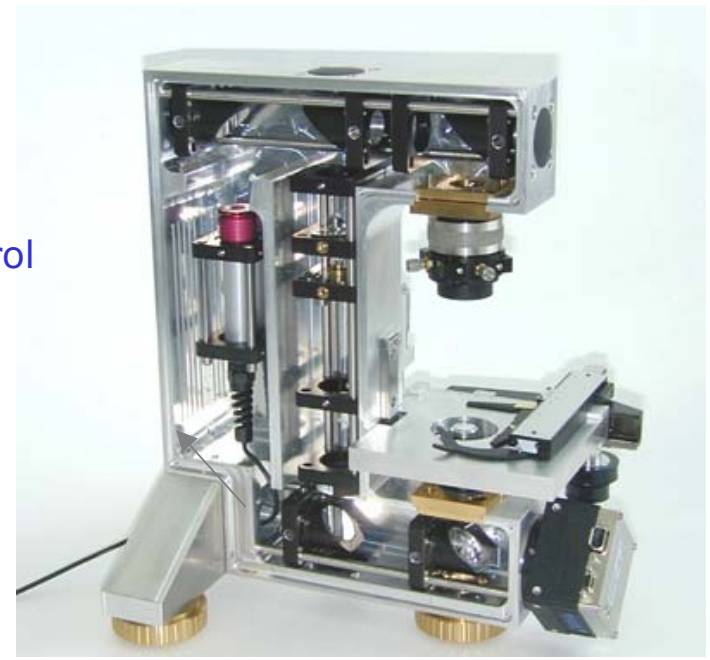
Micro optics quality control

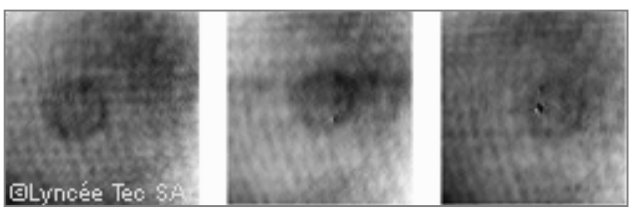


Surface 3D topography



Bio-support nano structure

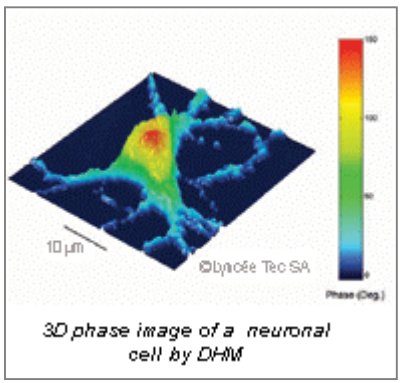




Quality control of spots on biochips

Research & Proof of Principle → Product Development → Prototyping → Market Introduction → Production

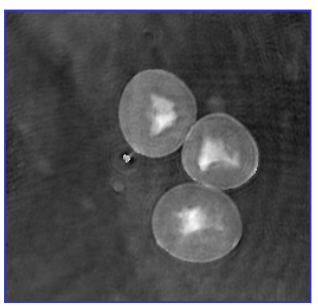
Life sciences



3D phase image of a neuronal cell by DHM

Cellular biology: morphology change associated with external stimulations (drug, electro physiology, …)

Pollen recognition without contrast agents



Research & Proof of Principle | Product Development | Prototyping | Market Introduction | Production

Taking control of the AFM probe

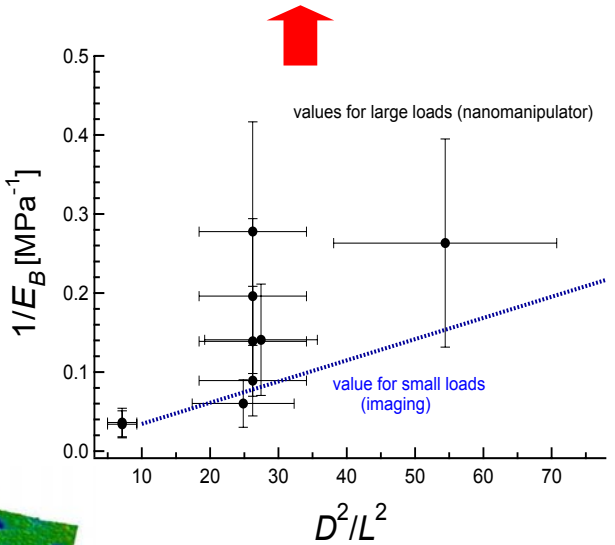
Tip

Probing the surface with the manipulator

Research & Proof of Principle | Product Development | Prototyping | Market Introduction | Production

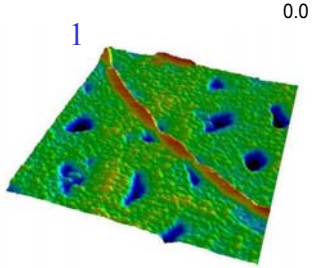
Mechanical properties of MT proteins

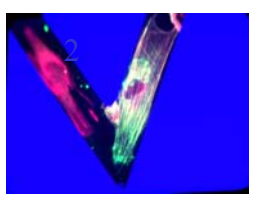
Microtubules are deposited on a porous surface and occasionally lie over holes. After an AFM image is taken, microtubule is bent using the nanomanipulator.
AFM tip is positioned in the middle of suspended microtubule and then pressed.
Raw force-displacement curves are obtained and processed to obtain force-deflection curves. Maximal forces and stresses acting on proteins can be estimated

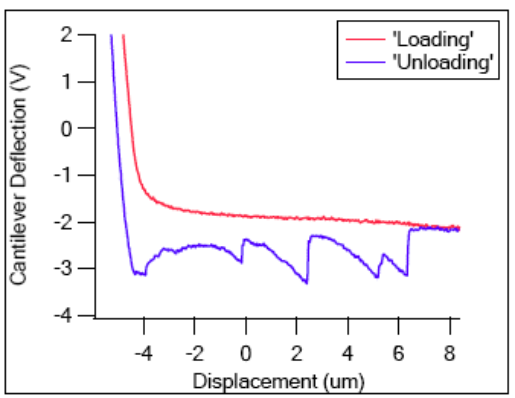


Investigation of cells binding forces

An adherents junctions mechanically link the intracellular actin cytoskeleton of adjacent cells through transmembrane cadherins.
Myofibroblast are deposited of the end of an AFM probe, the probe is then used to approach a substrate covered by fibroblasts. Using the nano manipulator, we monitor the cantilever deflection, the force, while the user moves in Z direction. The “steps” shown in the obtained curve, shows the adherentsjunctions between the observed cells.

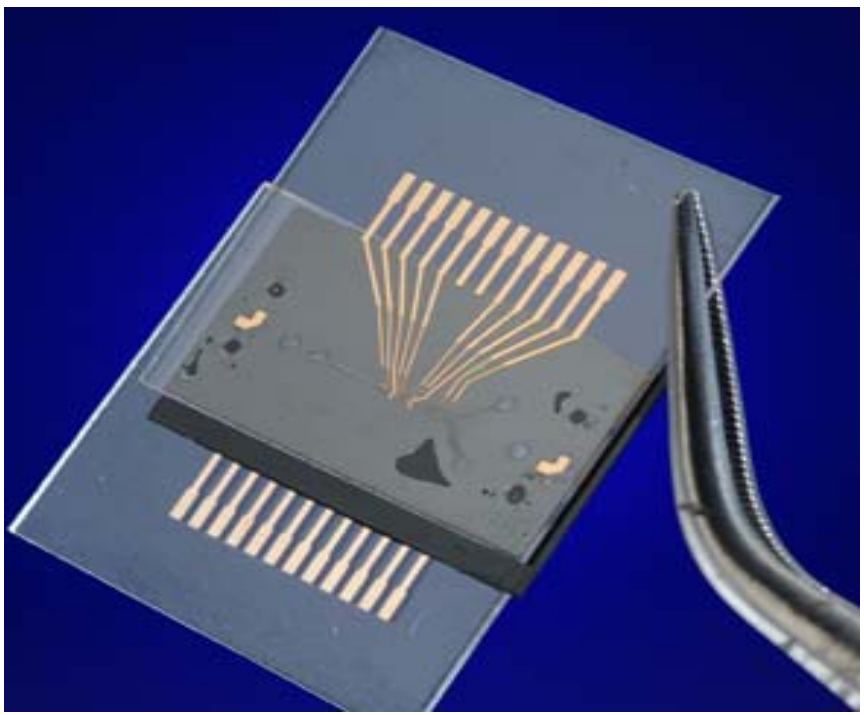






Sample : Ph. Pittet

Cell characterization in microfluidic devices by electrical impededance spectroscopy



Research & Proof of Principle | Product Development | Prototyping | Market Introduction | Production

Functionalities

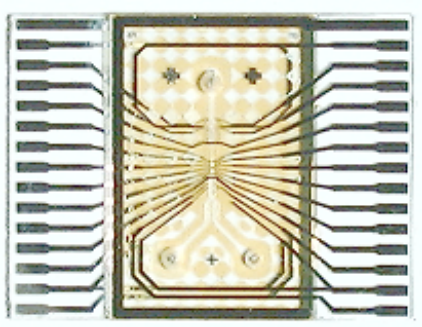
- Cell Counting
- Cell Identification
- Cell Characterization
- Cell Sorting

Benefits

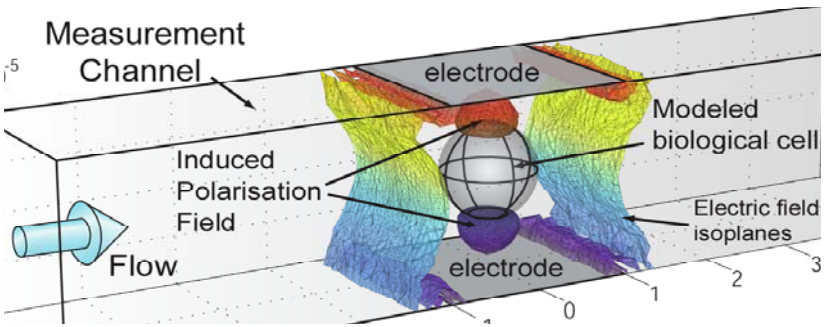
- Label free
- Gentle cell handling
- Smaller form factor
- Lower costs

On-Chip Electrical Flow Cytometry

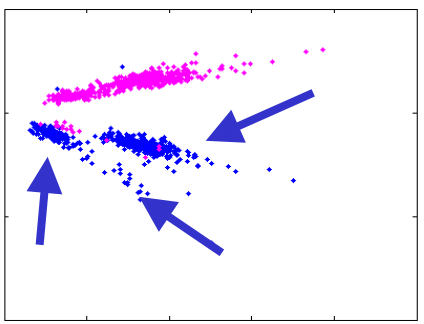
Biological differences of cells result in changes in their electrical characteristics.



Electrical fingerprint is taken while cells are passing through microfluidic channel.



Research Status: Biological different cells are clearly identified.

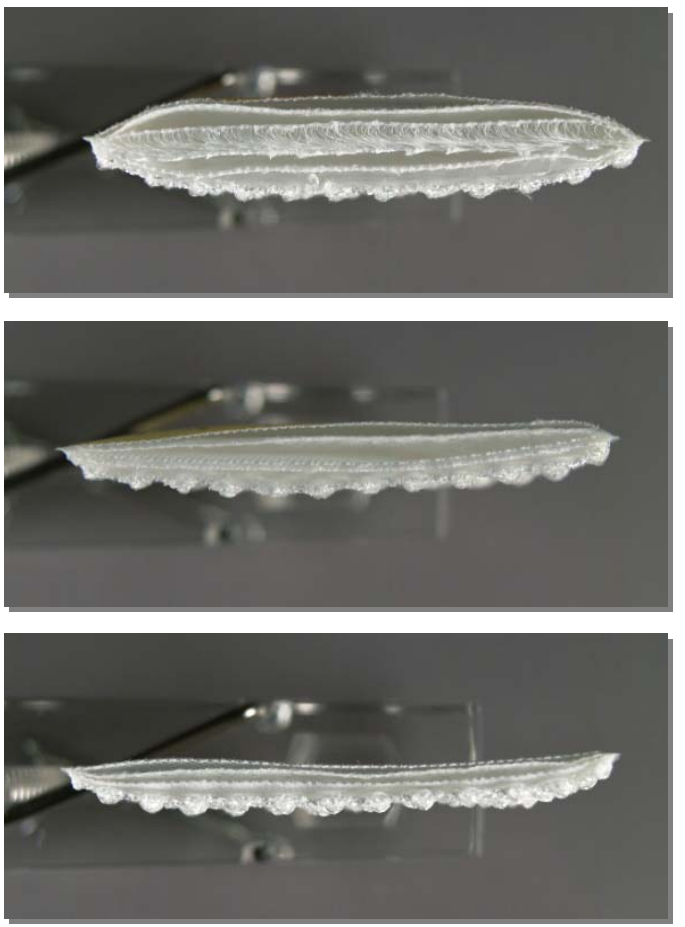


TISSUPOR® Wound Pads are wound compresses consisting of the following four components:

- Super absorbing viscose
- Spacer Fabric polyester
- Dense Fabric polyester
- Embroidered Textile polyamide

- Potential for functionalised surfaces

Research & Proof of Principle | Product Development | Prototyping | Market Introduction | Production



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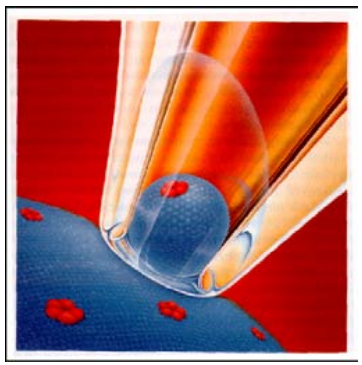
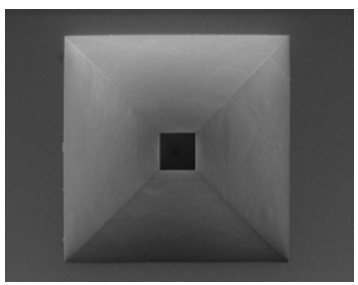
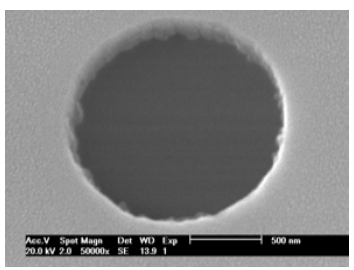
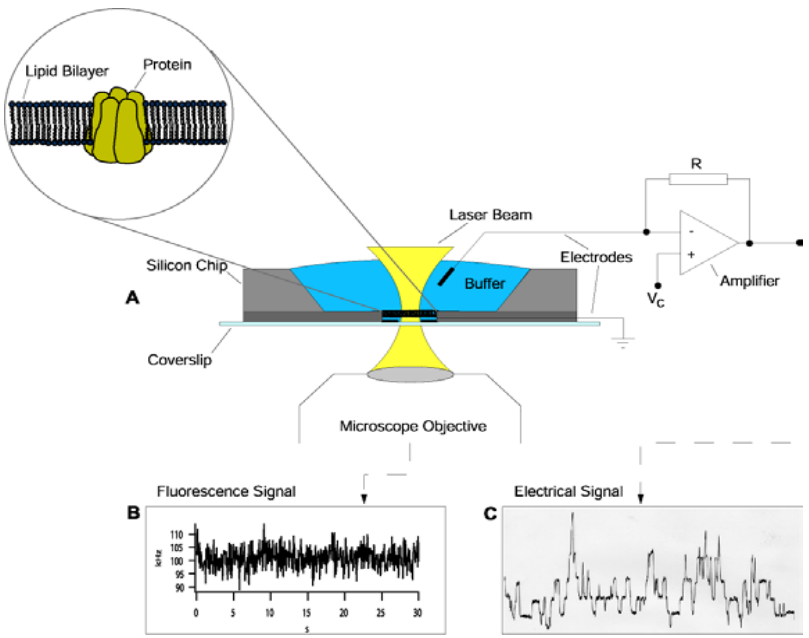






Electrophysiology on a chip:

Planar patch clamp & optical recording to probe cellular signalling



Benefits:
Fully automized
Saving time & consumable

Applications:
Functional screening
in pharma, R&D

Downscaling cellular signaling in micro arrays of single vesicles

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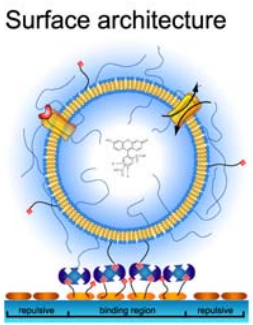

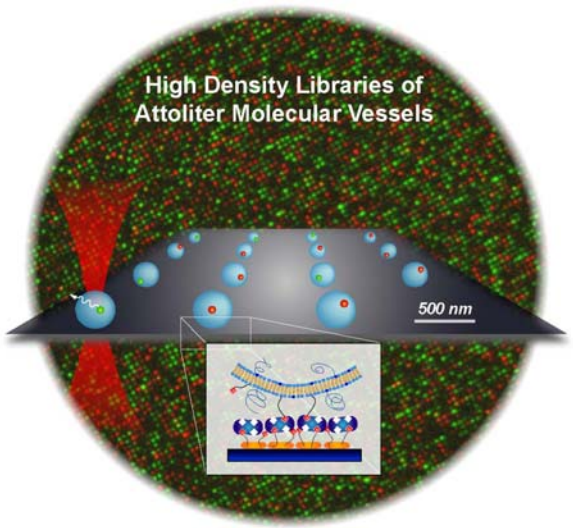

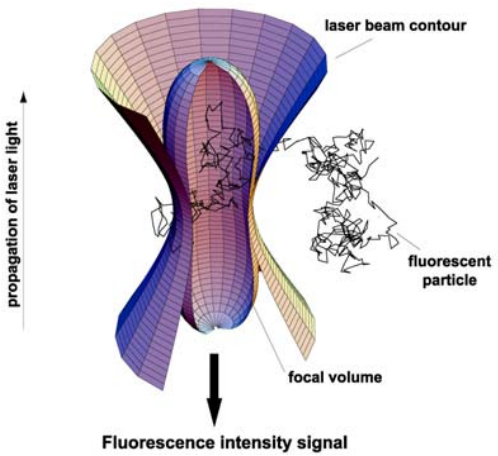

Applications

- Single molecule (bio)chemistry
- Proteomics
- Functional screening in
  - Pharma
  - Food
  - Environment
  - Fundamental R&D

Further Applications under Development

- ✓ Replications (for assays, cell growth, security labels, …
- ✓ Bio compatible surfaces, functional surfaces
- ✓ Functional surfaces
- ✓ Smart materials
- ✓ Nano composites
- ✓ Nano containers (drugs, odours, markers, …)
- ✓ …

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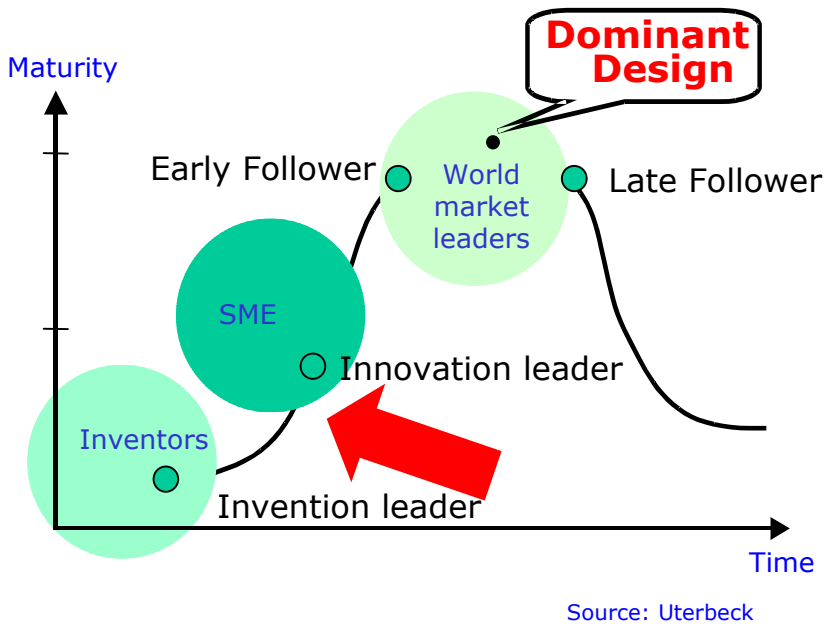
Limitations of Nanotech in healthcare



Source: Uterbeck

1. Early stage, new findings every week
2. Technology under development
3. New materials or the influence of dimensions (surface/volume, size, ..) not fully understood
4. Open questions with respect to risks

Inherent risks of Nanotechnologies (a first overview)

Materials/ Powders	Nanobio/ NanoMedicine	Devices	Instrumentation	Nanofactory/ Replication
- Novel Materials - Nano Particles - Surfaces	- Biomaterials - Life Sciences	- Optical Devices - Light Sources - Sensors - Energy Storage - Photovoltaics	- Tips and Probes - Data Storage	- Machining - Self Assembly
Environmental Risks	Environmental Risks	Environmental Risks	Environmental Risks	Environmental Risks
Toxicity	Toxicity	Toxicity	Toxicity	Toxicity
Societal Impacts	Societal Impacts	Societal Impacts	Societal Impacts	Societal Impacts
Economic uncertainty	Economic uncertainty	Economic uncertainty	Economic uncertainty	Economic uncertainty

No or little risks | Medium risks | High risks

Download your personnel copy of the TEMAS report:

Overview of completed and ongoing actives in the field:

Safety and Risks of Nanotechnology

(global)

www.temas.ch

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Current challenges and barriers

Challenges

1. Enabling technology for new functions
2. Emerging markets for life science products
3. Therapy
4. Home care
5. Bionics
6. Analytics
7. Pharmacology
8. Single molecule and single cell based systems

Barriers

1. Limited resources (human, financial, …)
2. High risk
3. Long incubation time
4. Clinical trial
5. Approval by agencies
6. Critical question from the public about safety and risks of Nanotech
7. Disruptive technology

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Strong position of Switzerland in Nanotech

- ✓ Cantilever Applications for AFM, STM, SPM, Arrays, Sensors (at the ultimate limits)
- ✓ NANO Biology (NANO-Containers, Single Molecule Detection,...)
- ✓ NANO Factory (Machining, Assembling, Manipulation, Handling)
- ✓ NANO Materials (Powders, Composites, CNT)
- ✓ Instrumentation

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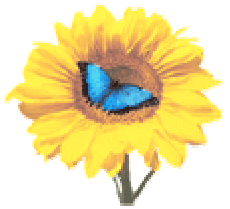
What will Nanomedicine mean

- ✓ New technologies to improve existing functions
- ✓ New technologies for new functions
- ✓ A better understanding of our environment and living cells

- ✓ Nano will open new fields of application in diagnostics, pharmaceuticals (e.g. drug delivery), medical implants, new materials, therapeutics, ….

- ✓ Fast analytical results (lab on chip), from hours to seconds

- ✓ A challenge to strengthen the existing market position, opportunities for new markets



Innovation means seeing
what everybody sees and anticipating
what no one has anticipated

Thanks to the organizer and to all visitors!

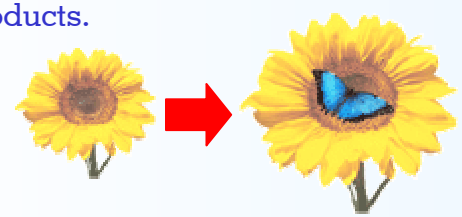
Download the presentation: www.temas.ch

Efficient services for your innovation process

TEMAS Technologie Treuhand

TEMAS Technology Impulse®

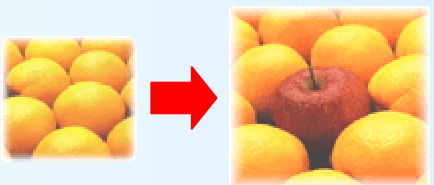
Impulses for your innovation process; increased customer benefit through new functionalities for existing or new products.



The TEMAS Technology Impulse supports you in generating added value.

TEMAS Technology Scout®

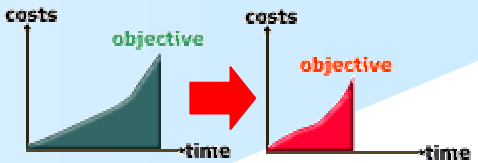
With the TEMAS Technology Scout you will find the best suited experts and partners for your specific requirements.



The TEMAS Technology Scout supports you in shortening your development times and costs.

TEMAS Technology Coaching

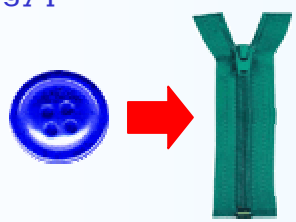
Secure achievement of project objectives by active accompaniment and coaching of your team, timely and within budget.



With the TEMAS Technology Coaching you will reach your goal safely.

TEMAS Technology Flash®

Show added value, tight core competencies, and recognize degrees of maturity by accurate analysis of your technology portfolio.



The TEMAS Technology Flash gives you security for your decision processes.