Trends in Nano/Micro Technologies

Panelists:

Christian Woegerer, Profactor GmbH, Austria

Leo Schranzhofer, Profactor GmbH, Austria

Adrien Brunet, Karlsruhe Institute of Technology, Germany

Timm Bostelmann, University of Applied Sciences, Germany

Moderator:

Victor Ovchinnikov, Aalto University, Finland

Primary trends

- Patterning methods
  - X-ray
  - Multipatterning
  - Nanoimprint
- Functional and technological materials
  - 2D materials: graphene, MoS_2
  - Quantified doping
- Device design
  - FinFET
  - FPGA
- Device simulation
  - Prediction of functional properties
  - Process step simulation

Secondary trends

- Science development
  - Cryogenics
  - Quantum technologies
- Micrometrology
  - AFM
  - Neai-field microscopy
- Process equipment
  - PC control
  - Robotics
- Social effect – economics, health, environment …
  - Is life possible without PC and mobile phones?
  - Tomography

Panel subtopics

- Nano - hype is over ?
  Christian Wögerer

- Nano safety and the potential risks of using nanomaterials
  Leo Schranzhofer

- How much heterogeneity a universal FPGA can cope with and how application-domain-specific optimizations might change the game
  Timm Bostelmann

- Priorities on Advanced Manufacturing of Multi-Material Multi-functional Products. The conclusions of the 4M experts toward 2020
  Adrien Brunet

Major output

- Panelists should be from different universities or companies. In our case, two persons were from Profactor GmbH

- Panelists should have a list of questions to audience (home task) to facilitate discussion

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28.7.2016 – Nice

Christian Wögerer

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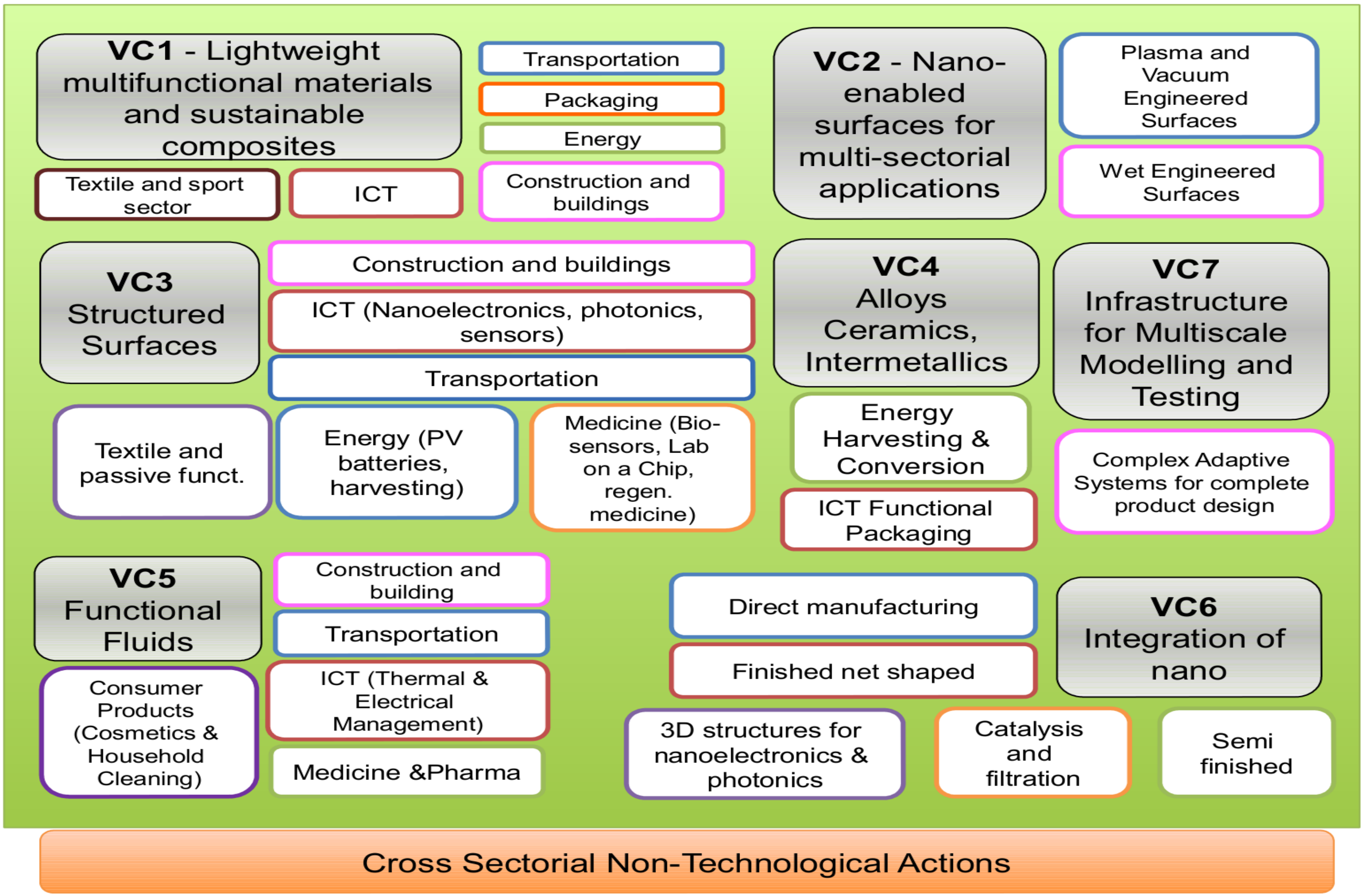
Trends in Nano/Micro Technologies

Thesis:

- Nano - hype is over and promised too much
- Integration of products of our daily live is sometimes successful realized
- To less attention on Manufacturing and Integration from the beginning
- Nano is only an “enabler” for micro products

Trends in Nano Nanofutures Roadmap (2012)

Roadmap Overview



From Nano to Production – Pilot Lines in 2017

The Value Chains are:

- VC1 - Nano and micro printing for industrial manufacturing
- VC2 - Nano-enabled, depollutant and self-cleaning surfaces
- VC3 - Manufacturing of powders made of functional alloys, ceramics and intermetallics
- VC4 - Lightweight multifunctional materials and composites for transportation

Pilot Line ID	Title of the Pilot Line	Value Chain
Pilot Line	**Nanostructured surfaces and nanocoatings,** divided into: • Pilot 1a: Nanostructured antimicrobial, antiviral surfaces for medical devices, hospitals, etc. • Pilot 1b: Nanocoatings for mechanically enhanced surfaces	VC2
Pilot Line 2	**Manufacturing of lightweight multifunctional materials with nano-enabled customised thermal/electrical conductivity properties**	VC4
Pilot Line 3	**Printed microfluidic MEMS and biological applications** divided into: • Pilot 3a: Nozzles, filters, sensor applications and multi-use chip • Pilot 3b: Bio-medical/bio-physicals sensors, actuators and other devices	VC1
Pilot Line 4	**Non mainstream Micro-Electro-Mechanical Systems and Architectures**" related to: • Pilot 4a: Advanced CMOS compatible digital fabrication • Pilot 4b: Cheap flexible hybrid or full polymer MEMS ecosystems	VC1

Trends in Nano/Micro Technologies

Trends from my view:

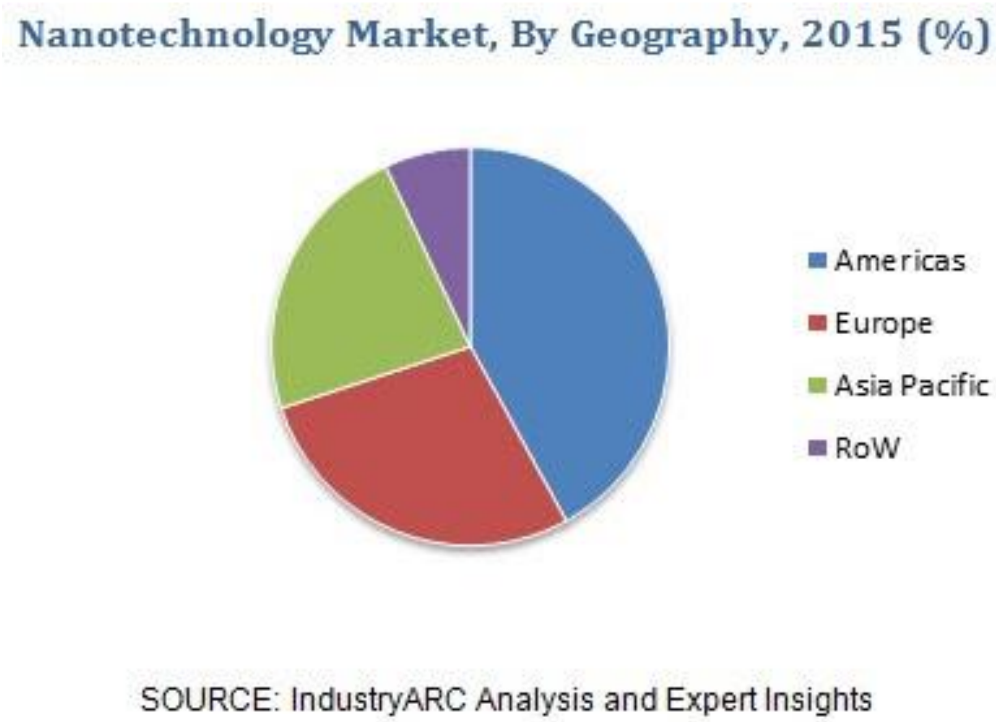
- Additive Manufacturing of Micro/Nano based Products
  Freedom of Design, Flexibility of fabrication, Process integration and shortening the value chain
- Multi-material hybrid Products
  Nanotechnologie enables new Hybrid multi material products
- Highly customized Products on Small Lot sizes
  Miniaturized sensors in the micro range, flexible in design and material, from very large to small lot sizes

Trends in Nano/Micro Technologies

Some points to be discussed

- What are the drivers for this Trends? - How important is “Industry 4.0” for New Micro/Nano Trends? (CPS Cyber physical systems) – Cheap, simple and easy to manufacture sensors are needed? Industry 4.0 is more than Software
- Which role is Europe playing against US and Far East. What are the strength of Europe against his competitors?

Nanotechnology Market and Market Trends 2021



Europe and APAC regions are projected to have the highest growth in this market in the upcoming years due to the extensive research and development activities under process in various universities and research centers in this sector

Panel:
Trends in Nano/Micro Technologies

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Adrien Brunet

What is 4M2020?

Coordinated Support Action

“Advanced Manufacturing of Multi-Material Multi-Functional Products Towards 2020 and Beyond”

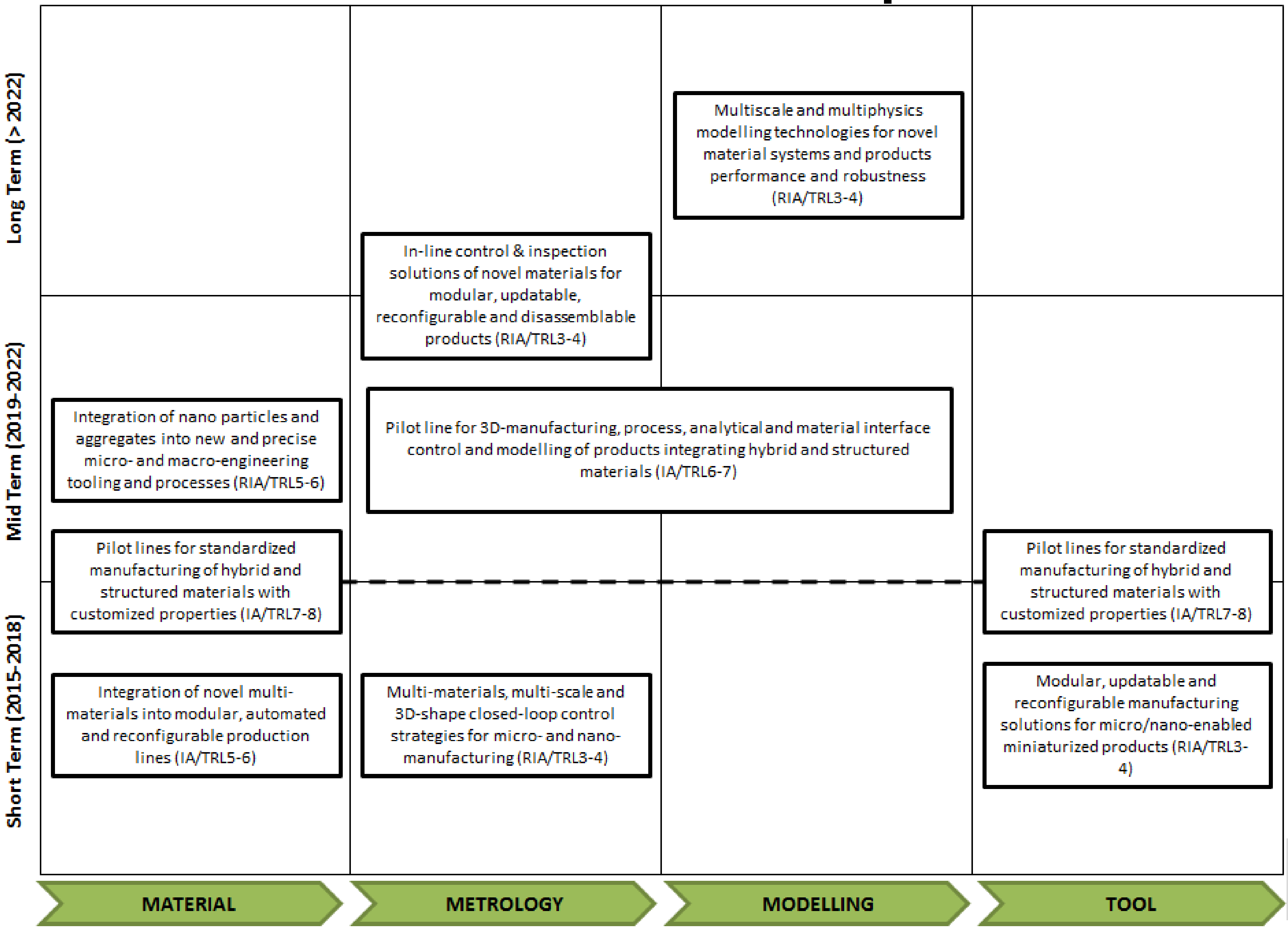
Start date: 1st September 2013

End date: 31st August 2016

Our Vision: Promote and facilitate cross-fertilisation between advanced manufacturing platforms to create alliances based on interrelated research and product demonstration activities.

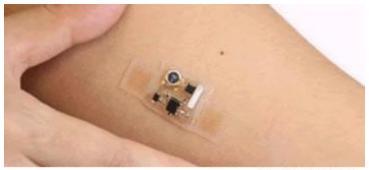
4M2020 roadmap

Karlsruhe Institute of Technology



High priority products

Customised health monitoring



Health Monitor

Flexible screens

Samsung flexible AMOLED display

Sensors for environment monitoring

Environmental monitoring microchip

In-line metrology

Inline inspection

Fuel cell for electric cars

Fuel cell car chassis

Micro sensors integrated in machine tool inserts

Sensors for grinding machines monitoring

Micro-parts for wearable devices

I Watch

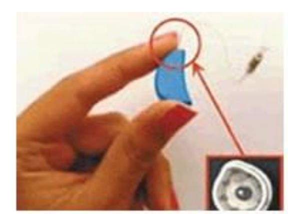
Energy efficient buildings

Energy harvesting

Micro-gas turbines and bearings

Micro gas turbine

µ-connectors



8 Pin RIC socket for hearing aid

Questions

Karlsruhe Institute of Technology

- Would you agree with the conclusion of 4M2020
- Why should we use nanoparticles?
- Why should we develop multimaterial devices?

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Nano Safety

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Nanosafety

- Ways into the body
  - Aerosols respirable
  - Penetration through skin
  - Uptake over digestion
- Mostly unknown hazardness of nanomaterials
- Large differences between bulk and nanomaterial
  - Large surface to volume ratio
  - Catalytically function of nanomaterials
  - Possible penetration through various tissue
- Detection of Nanomaterials
  - Usually cost and time consuming

Problem Solving

- Declaring clearly about the content
- Creating a certain awareness for users
- What can be done on acute contamination
- Avoiding formation of aerosols of smaller particles (below 500nm)
- Avoiding unnecessary use of nanoparticles in consumer goods (TiO2 in chocolate, etc.)

How much Heterogeneity can Universal FPGAs cope With and how Might Application-Domain-Specific Optimizations Change the Game?

Timm Bostelmann

FH Wedel
University of Applied Sciences

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Observations

Observation I

Universal FPGAs get more and more heterogeneous.

- Versatile DSP-Blocks
- Various Memory-Blocks and Interfaces
- Sophisticated I/O-Cores
- Powerful Microcontrollers

Observation II

Many applications only use a small part of those special resources, if they use them at all.

Implications

Direct Implications

- Applications can benefit from special functions in reconfigurable logic.
- Different applications demand different functions.
- Low area-costs make function-overload possible.
- Efficiency is hampered by unused function-blocks.

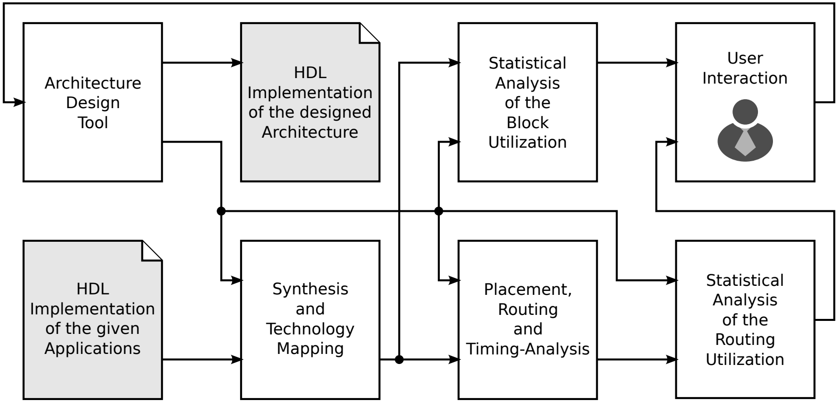
Indirect Implications

We might sacrifice universality in FPGAs and create application-domain-specific reconfigurable logic to...

1. remove unused special functions.
   $\rightarrow$ increase the device-utilization
2. integrate even more special functions and routing structures.
   $\rightarrow$ increase the speed and power-efficiency

Approach

Provide a designflow for the optimization of reconfigurable architectures.



What do you think?

1. Which of your applications are or could be accelerated by FPGAs?
2. Is heterogeneity in universal FPGAs really a problem?
3. Is it reasonable to optimize reconfigurable logic for application-domains?