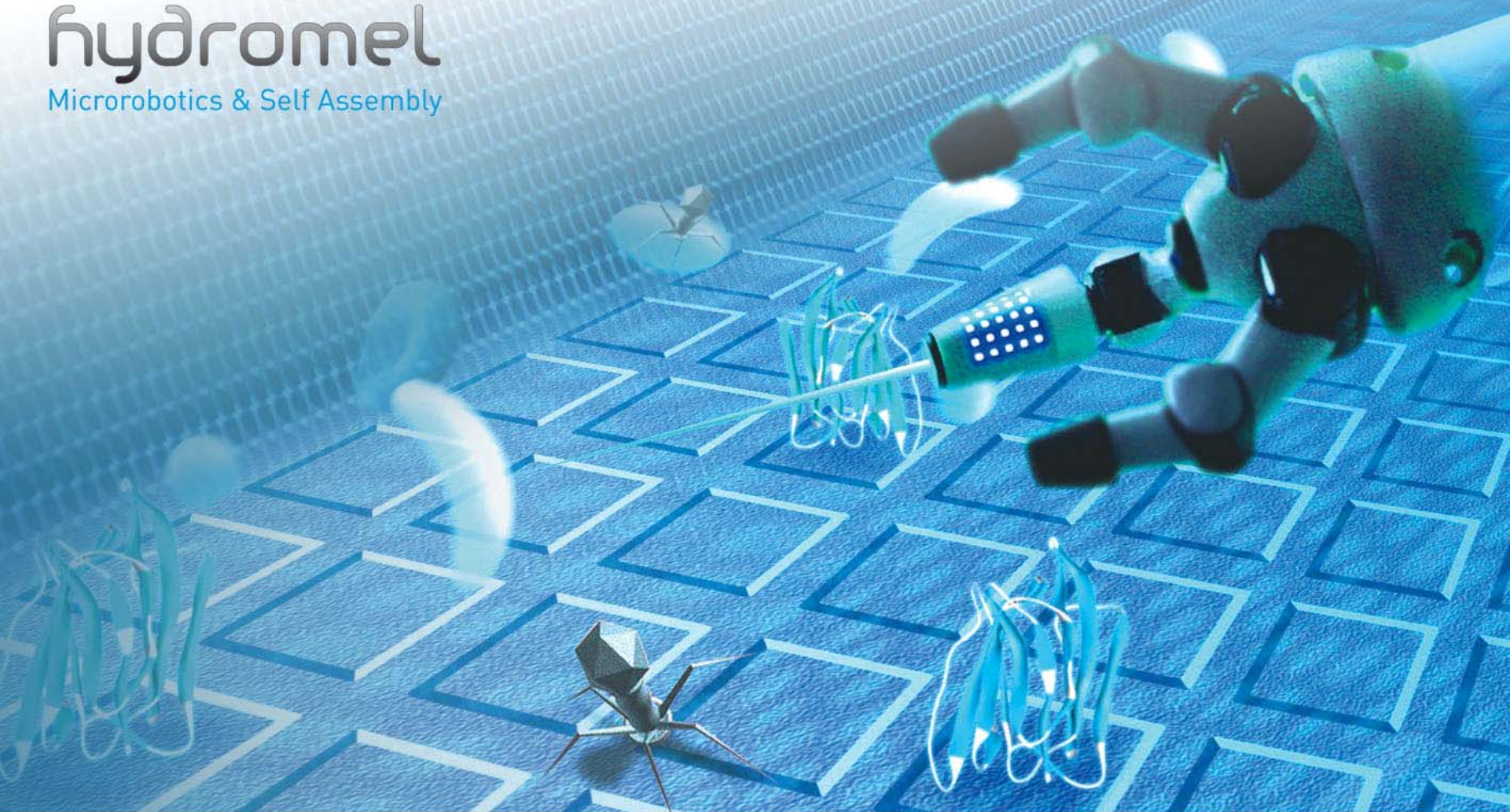


hydromel

Microrobotics & Self Assembly



A European Project supported within the sixth Framework Programme for Research and Technological Development

Combining Robotics with Self-Assembly: The HYDROMEL Project

IMS Workshop, November 16, 2007

Presented by: Helmut Knapp, CSEM, Switzerland

HYDROMEL

aims at developing new versatile 3D automated
production systems for complex micro-devices
through the innovative
combination of positional- and self-assembly.

Basics of microrobotics

Microsystems technology and nanotechnology require robots capable of handling very small objects with nanometer precision. Micro robots are regarded as one of the key issues for both these technologies. Especially the robot-based automation of nanohandling will lead to various novel applications.

Advantage:

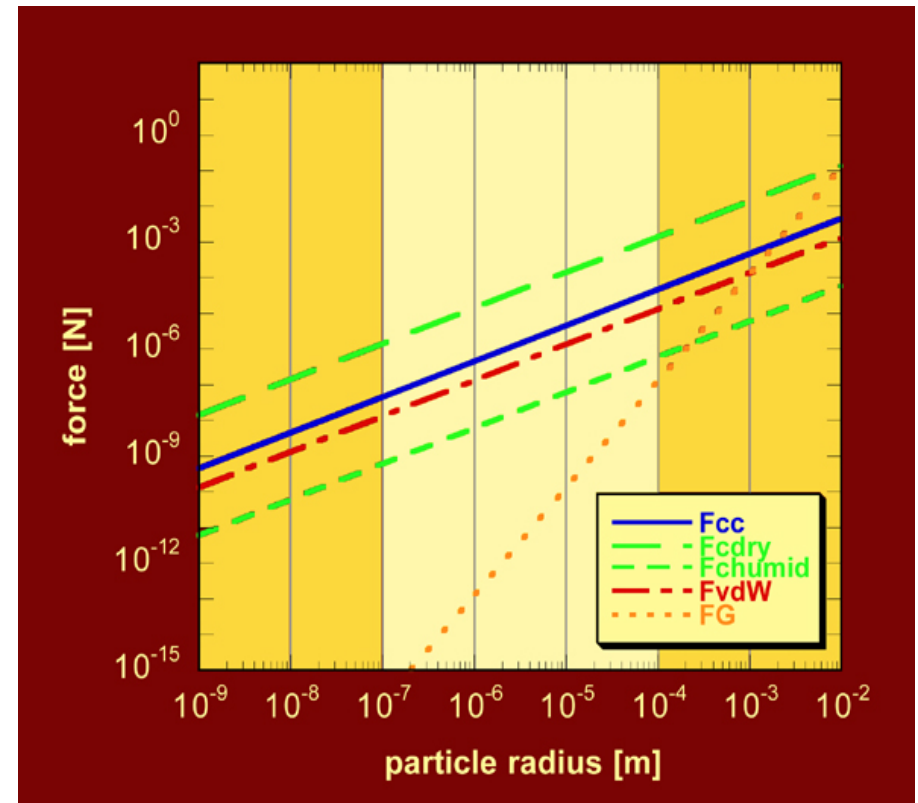
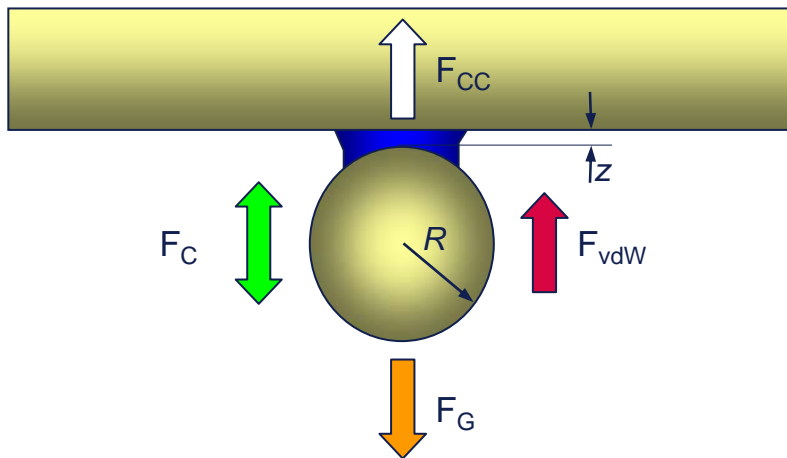
highly flexible, object oriented, directly controllable

Disadvantage:

serial, limited precision (compared to self-assembly)

Challenges of microrobotics

Dominant adhesive forces for
micro scale objects



Calculated for glass sphere and glass plate

Basics of self-assembly

“Self-assembly is the autonomous organization of components into patterns or structures without human intervention”

G.M. Whitesides, B. Grzybowski, Science 2002, 295, 2418-2421

One of its main advantages is that many objects can be handled in a massively parallel approach at nanometer accuracy.

Advantage:

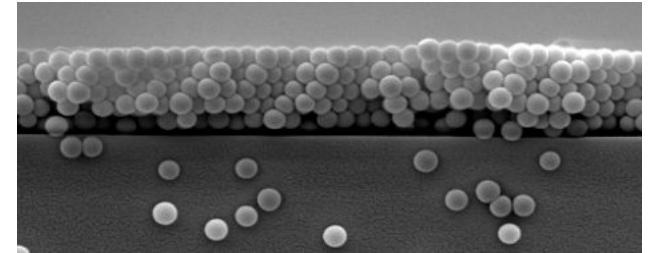
massively parallel, very precise (depending on interaction)

Disadvantage:

few degrees of freedom, not directly controllable

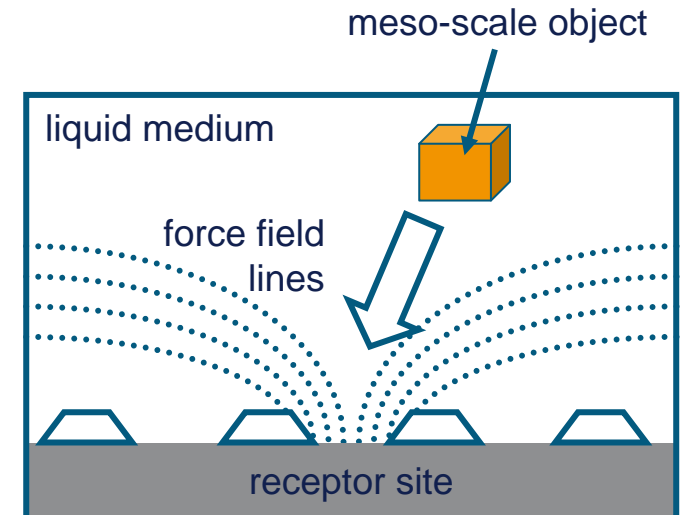
Challenges of self-assembly

self-assembly has almost exclusively been applied to create nano-scale assemblies from molecules, nano particles or biological entities



Source: CSEM

few examples have demonstrated self-assembly principles to the self-association and/or self-ordering of micro-to millimeter range objects



A New Approach

Top Down

Microrobotics



HYDROMEL

Hybrid Assembly:
robot assisted self-assembly &
self-assembly assisted Microrobotics

Bottom Up

Self-assembly



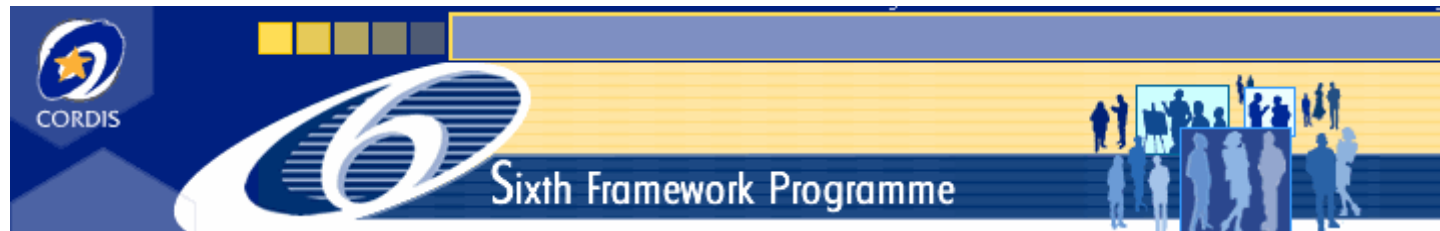
The Project – Key Figures

IP in FP6 under NMP

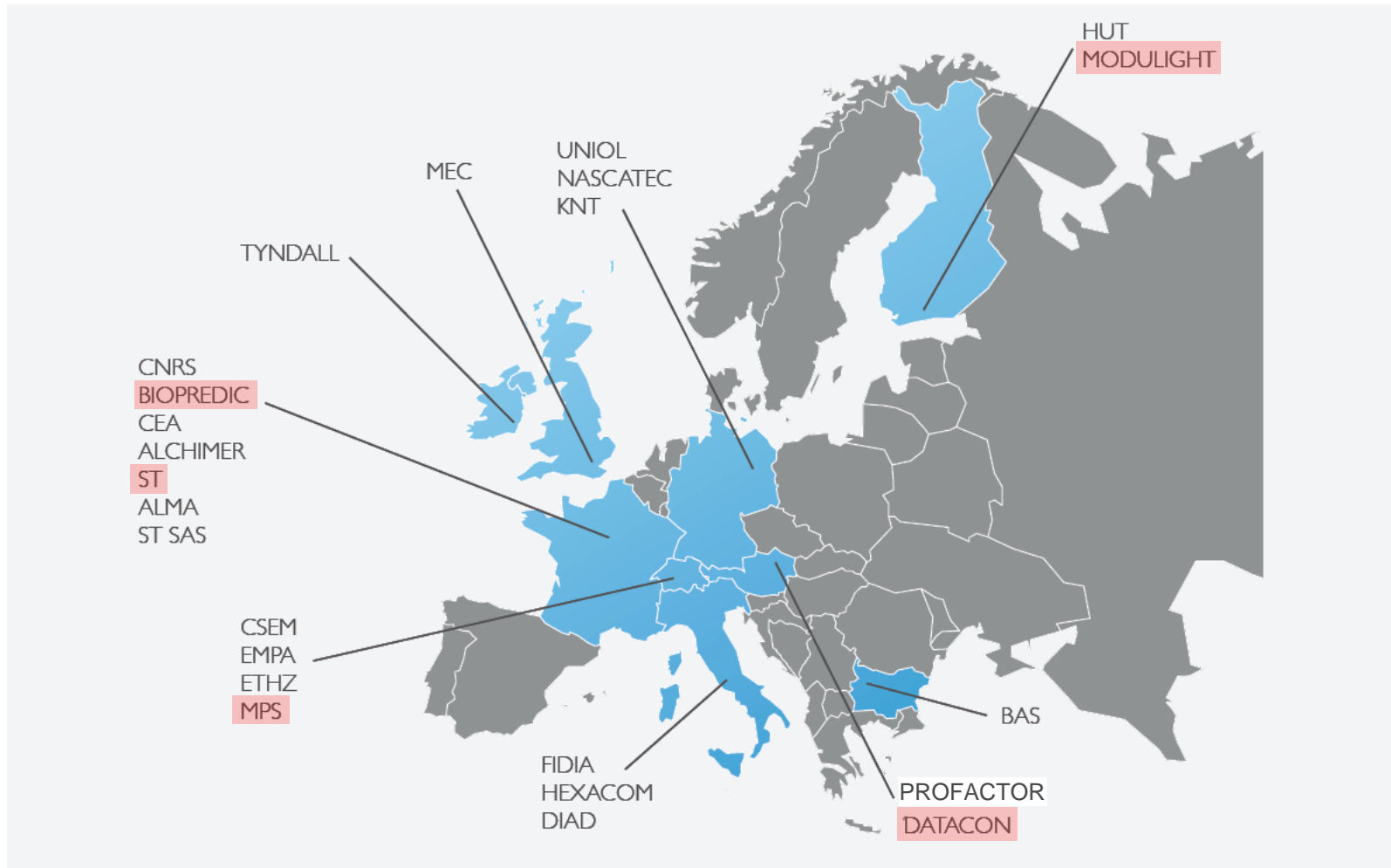
Overall budget of 13,87 Mio € (grant 9 Mio €)

24 Partners from 10 European countries

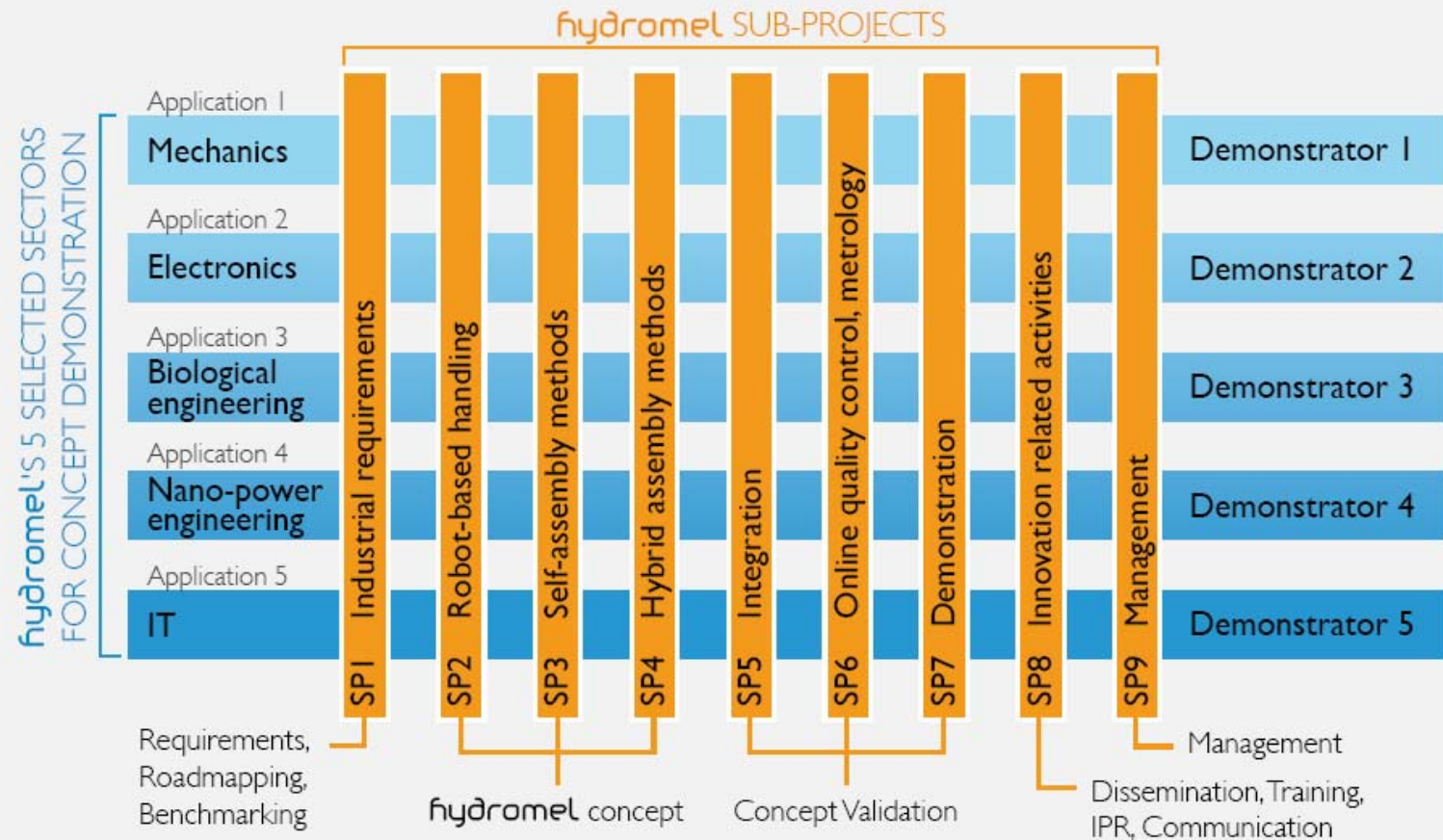
Duration of 48 months, running from 10/2006 – 09/2010



24 Partners Across Europe

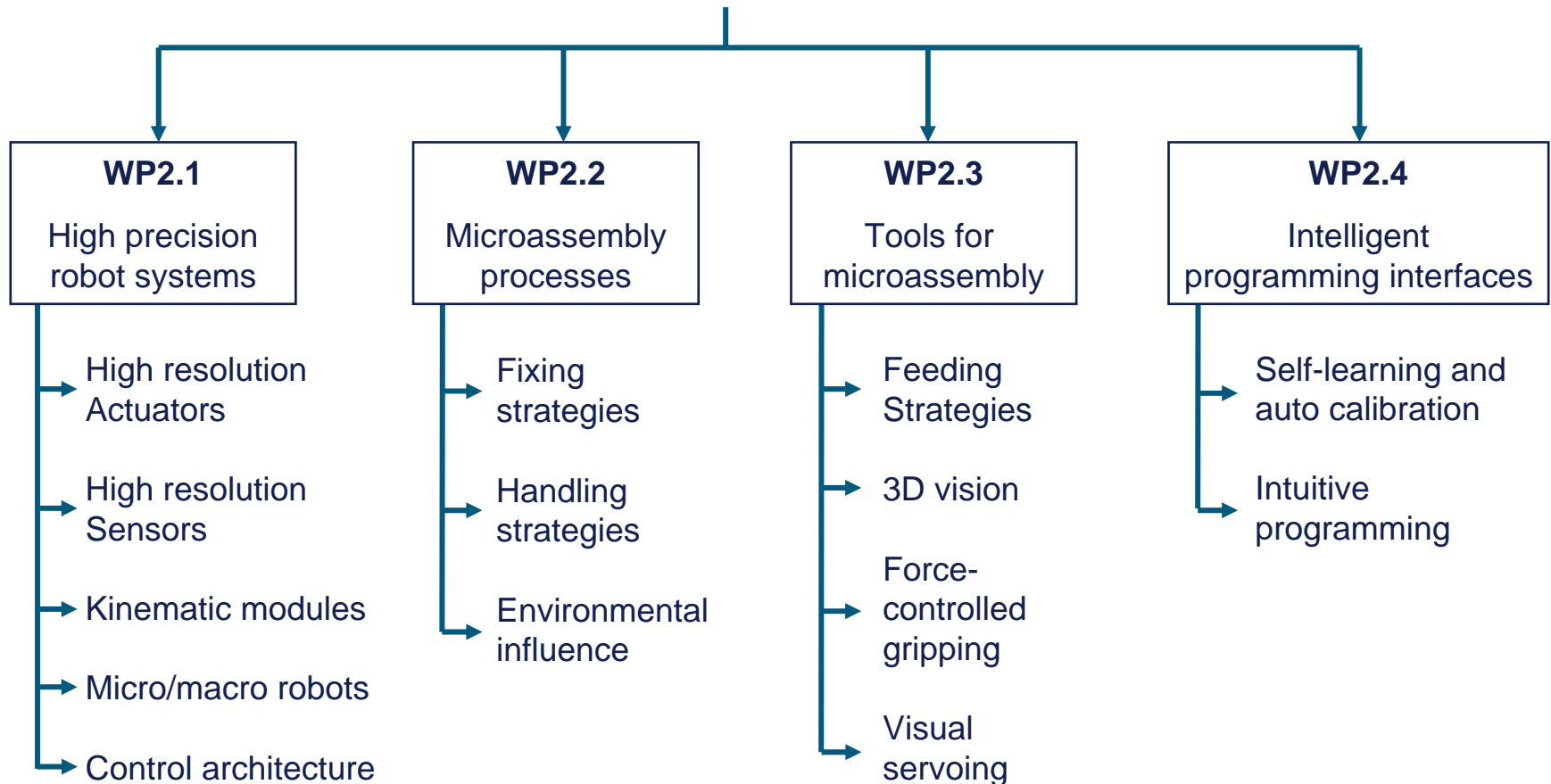


Project Organisation

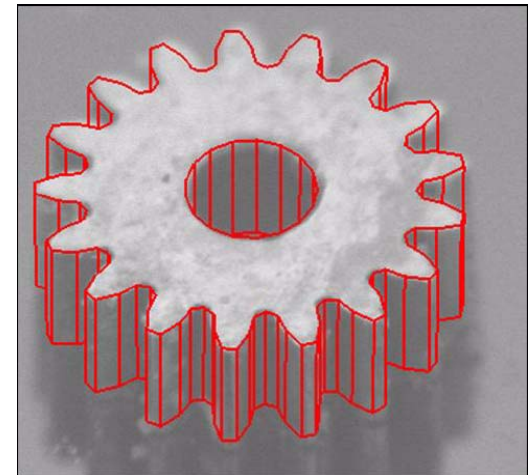
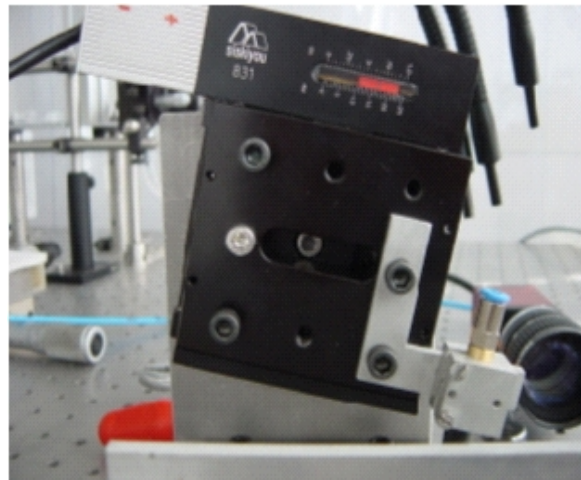
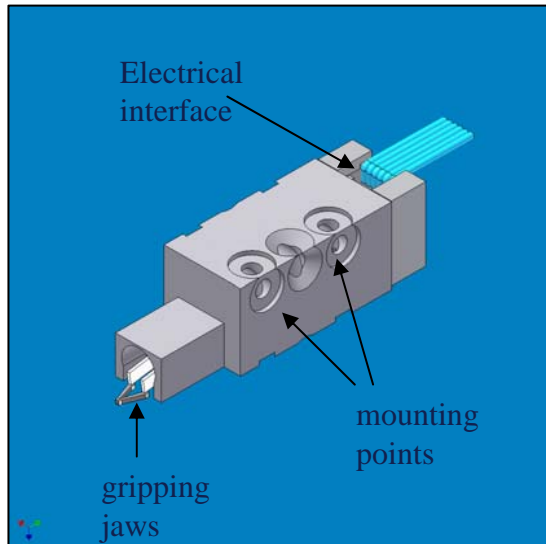
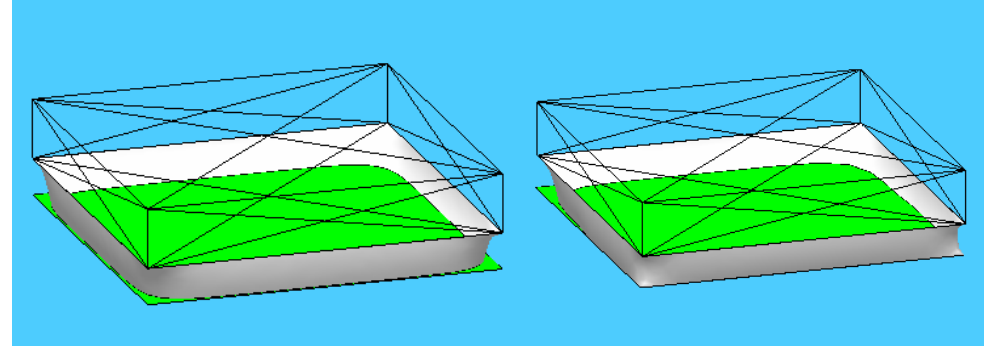
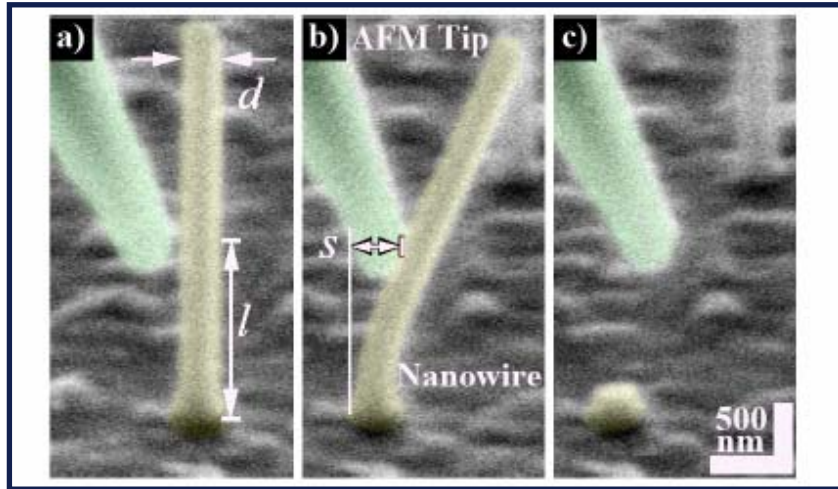


SP2 Robot Based Handling

SP2: ROBOT BASED HANDLING

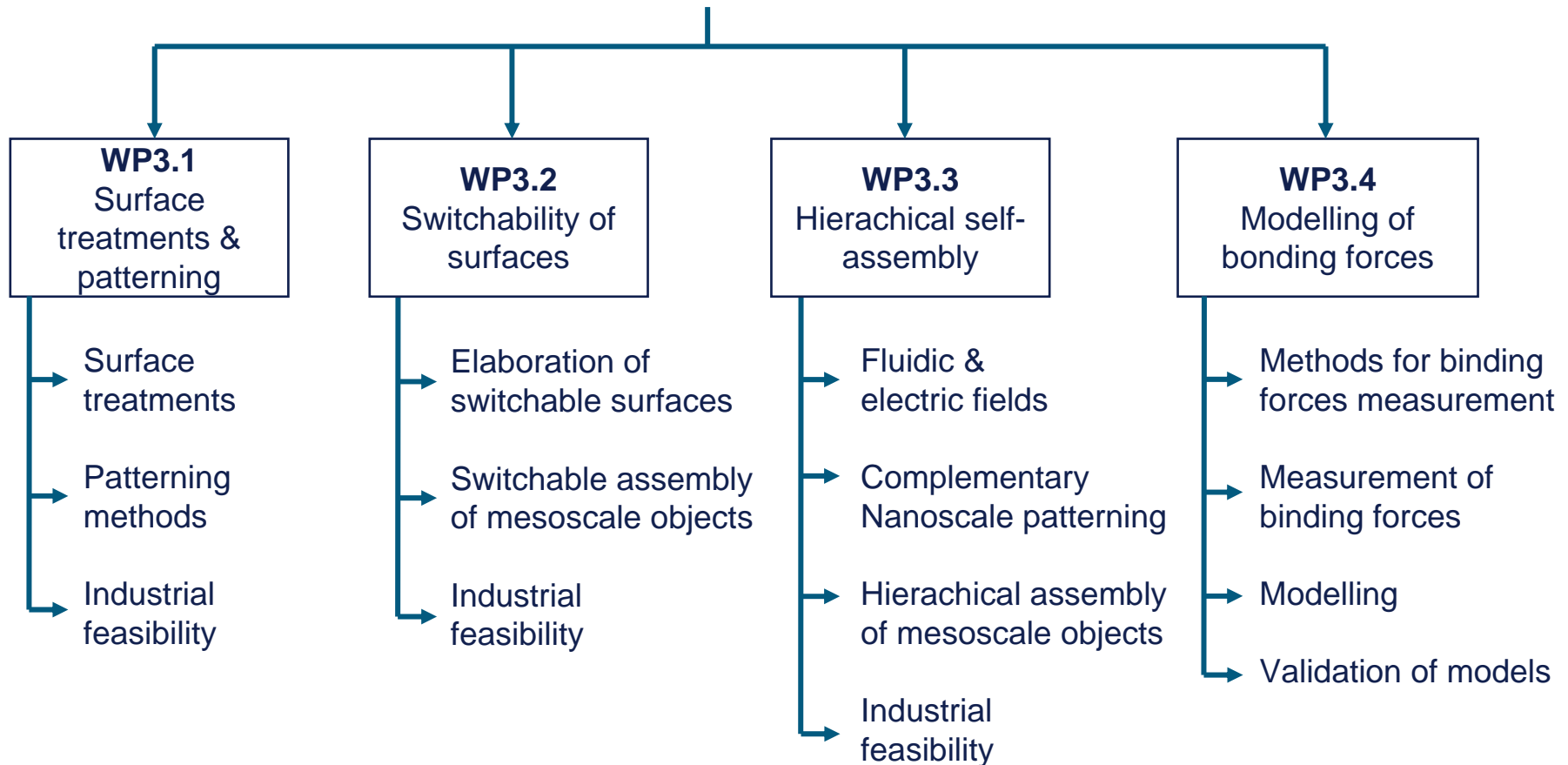


SP2 Robot Based Handling

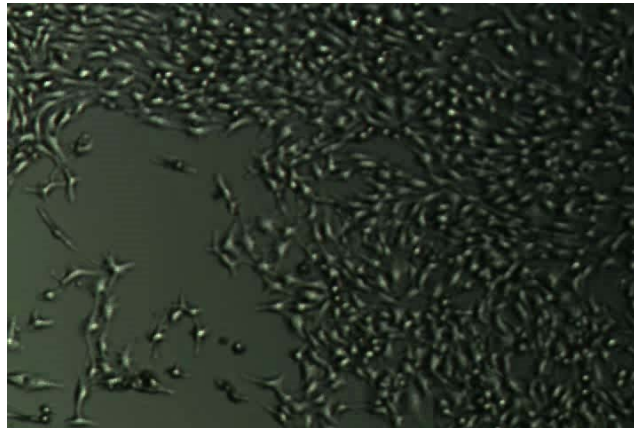
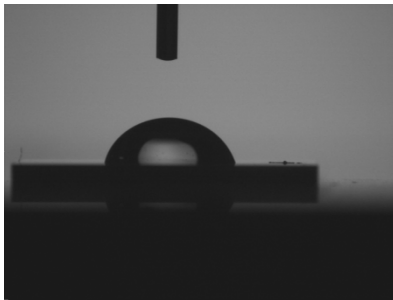
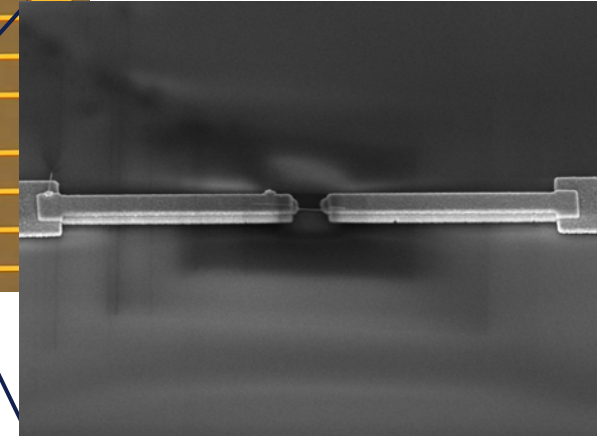
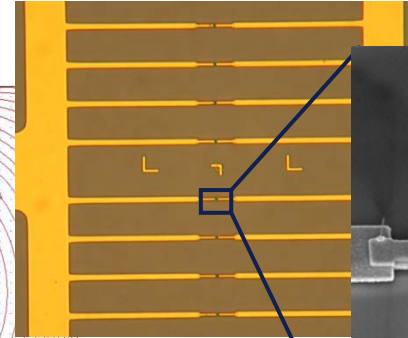
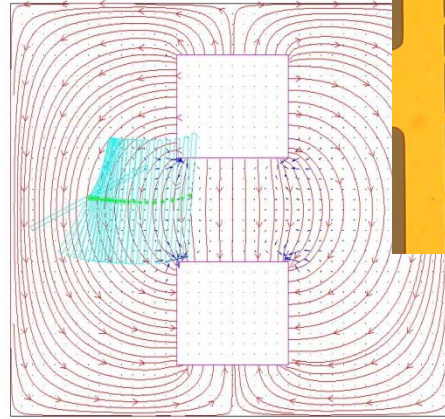
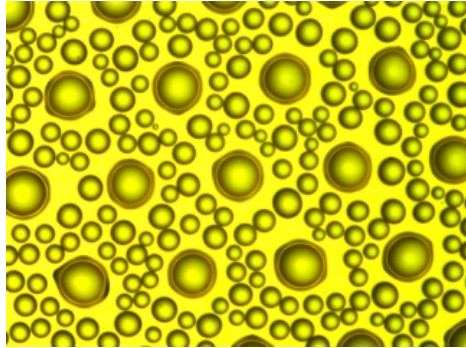


SP3 Self-Assembly Methods

SP3: Self-Assembly Methods



SP3: Self-Assembly Methods



SP4 Hybrid Assembly Methods

WP4.1

Methodologies for Self-Assembly Assisted Robotics

WP4.2

Methodologies for Robot Assisted Self-Assembly

SP5 Integration

WP5.1 Robot system setup

WP5.2 Integration of hybrid systems

WP5.3 Integration of self-assembly units

WP5.4 Integration of quality control

WP5.5 Design of most cost-effective process

WP5.6 Life-cycle analysis

Demonstrators

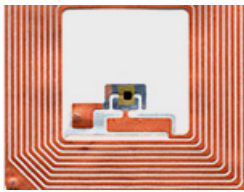
1

Micro
mechanics



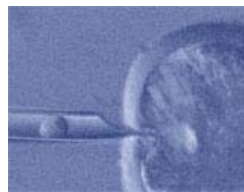
2

Electronics



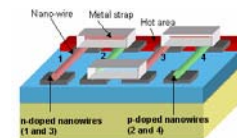
3

Bio-
technology



4

Nano power
engineering



5

IT



Demonstrator 1 - Micromechanics

1

Micro
mechanics



Goal

- assembly of micromechanical device, part size $\ll 1$ mm

Robotic aspect

- pick & place of micro components

Self-assembly aspect

- assisted release and precise placement of component

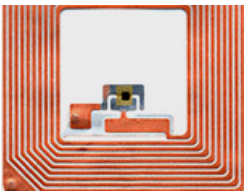
Quality aspect

- visual surface inspection

Demonstrator 2 - Electronics

2

Electronics



Goal

- high throughput assembly of hybrid e-device (die on substrate)

Robotic aspect

- pre-alignment of components

Self-assembly aspect

- parallel fine alignment by controlled adhesion

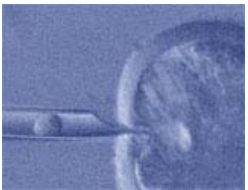
Quality aspect

- electrical characterization

Demonstrator 3 - Biotechnology

3

Bio-
technology



Goal

- controlled and safe injection into cells

Robotic aspect

- positioning of tools

Self-assembly aspect

- automated fixation of cells (reversible)

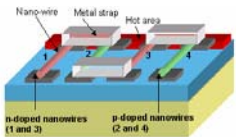
Quality aspect

- vision control of process

Demonstrator 4 – Nano engineering

4

Nano power
engineering



Goal

- assembly of hybrid MEMS including nanowires

Robotic aspect

- serial positioning of nanowires

Self-assembly aspect

- automated growths / manipulation of nanowires

Quality aspect

- function of device

Demonstrator 5 – IT

5

IT



Goal

- inspection of MOEMS devices (laser diode arrays)

Robotic aspect

- coarse positioning of substrates

Self-assembly aspect

- auto-alignment of components

Quality aspect

- optical inspection of active surfaces

Dissemination and Training Activities

Check project portal for
content and related
activities

www.hydromel-project.eu



hydromel WebSite: Home - Mozilla Firefox

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

http://www.hydromel-project.eu/

hydromel WebSite: Home

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Monday 08 October 2007

Hydromel at a glance
Hydromel Partners
Work Description
News
Open Training Events
Download
Useful Links

Home :

Welcome to the HYDROMEL project

Hybrid ultra precision manufacturing process based on positional- and self-assembly for complex micro-products

The HYDROMEL project is supported by the European Commission through the [Sixth Framework Programme](#) for Research and Technological Development.

- To Make Europe World Leader in **Microassembly**
- HYDROMEL will bring the opportunity to join the research efforts of the best **European academic and R&D partners** in the fields of Microrobotics and Self-Assembly towards a common goal.
- It is **strongly supported by European Industry**, which has clearly identified the breakthrough that could come out of this innovative project

Delivery of free micro-devices
Receptor sites defined in silicon substrate

THANK YOU FOR YOUR FEEDBACK

Fertig

News
27 September 2007
One year meeting in Zurich
Core steering Board meeting on 24th October
[more]

Brochure
Hydromel_Brochure.pdf

A European project supported within the Sixth Framework Programme for Research and Technological

Statements

- The future of microassembly systems lies in modular compact units
 - ☞ Clean-room type environment can be restricted to the inside of the small units to reduce costs
 - ☞ Modules can be rearranged to enable affordable customized solutions
- Self-assembly can greatly facilitate microassembly needs
 - ☞ Improvement of alignment precision
 - ☞ Parallel processing