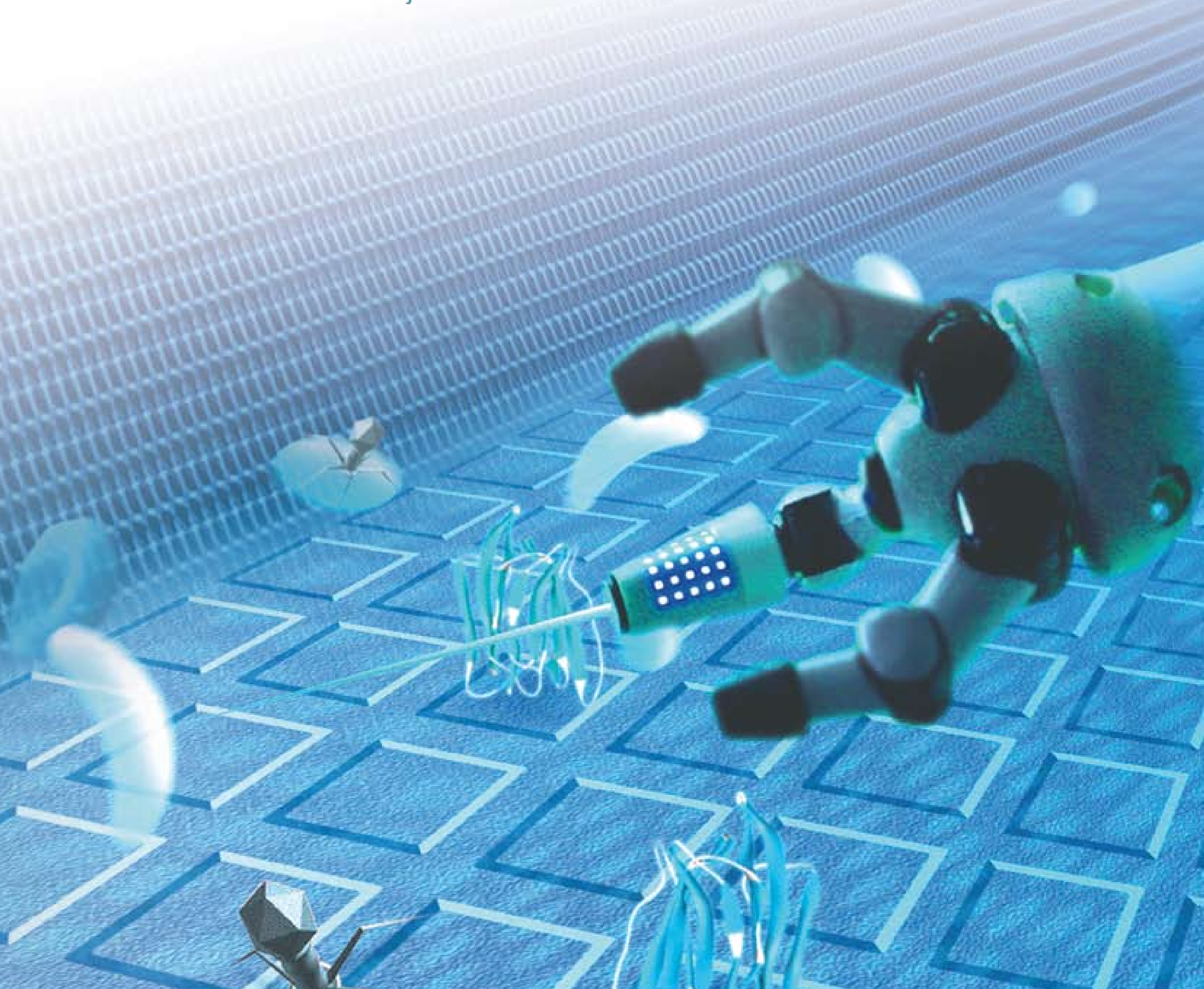
hydromel

Microrobotics & Self Assembly



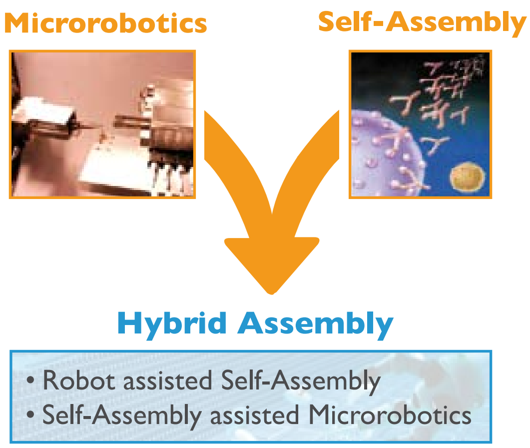
A European Integrated Project supported through the Sixth Framework Programme for Research and Technological Development

hydromel:

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

Context

Today, emerging highly complex micro-devices with applications **in mechanics, electronics, biological engineering, microfluidics** and IT request ultra precision manufacturing processes. To answer these needs, HYDROMEL aims at developing **new versatile 3D automated production system for complex micro-devices.** This radical breakthrough in micro assembly will become possible through the innovative combination of positional- and self-assembly.



Basics of microrobotics and self-assembly

• "Microsystems technology and nanotechnology require robots capable of handling very small objects with nanometer precision. These microrobots 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.

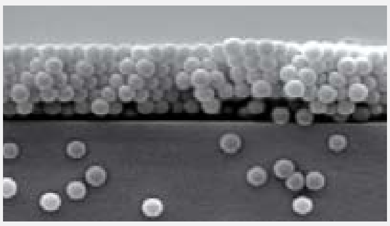
Disadvantage:
serial, limited precision (compared to self-assembly).

Small Nanorobotics system
from Klocke Nanotechnik

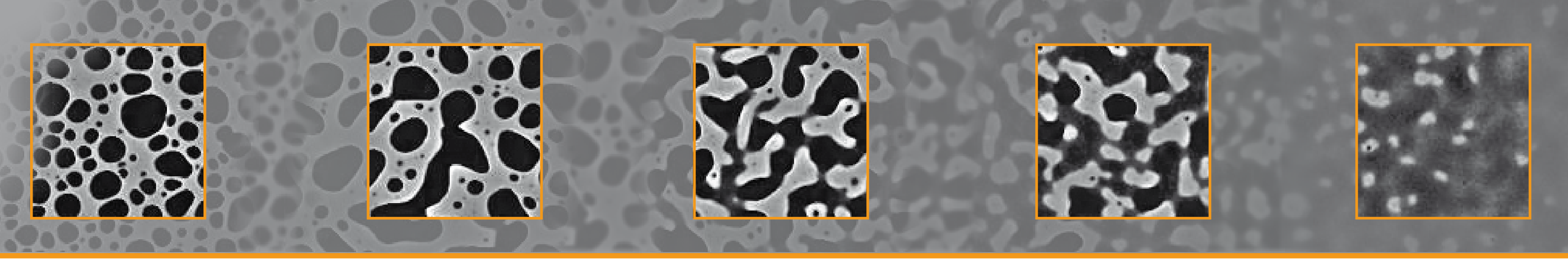
• "Self-assembly is the autonomous organization of components into patterns or structures without human intervention" G.M. Whitesides, B. Grzybowski, Science 2002, 295, 2418-2421. One of its main advantages is that many objects can be handled in a massively parallel approach at nanometer accuracy.

Advantage:
massively parallel, very precise (depending on interaction).

Disadvantage:
not directly controllable.



Self-assembled beads, courtesy of CSEM



Scientific Objectives

Scientific & Technical short-term objectives:

- To improve part handling manufacturing systems in terms of positioning accuracy **(down to the nm range), reliability, flexibility** (interchangeable grippers, tools, etc.) and reduced production **setup time** to reach optimal yield.
- To produce extended knowledge in self-assembly for (i) **surface treatments** and **surface patterning**, (ii) **surface reconfigurability,** (iii) **hierarchical self-assembly**, (iv) **modelling of forces** and (v) **dynamics of self-assembly.**

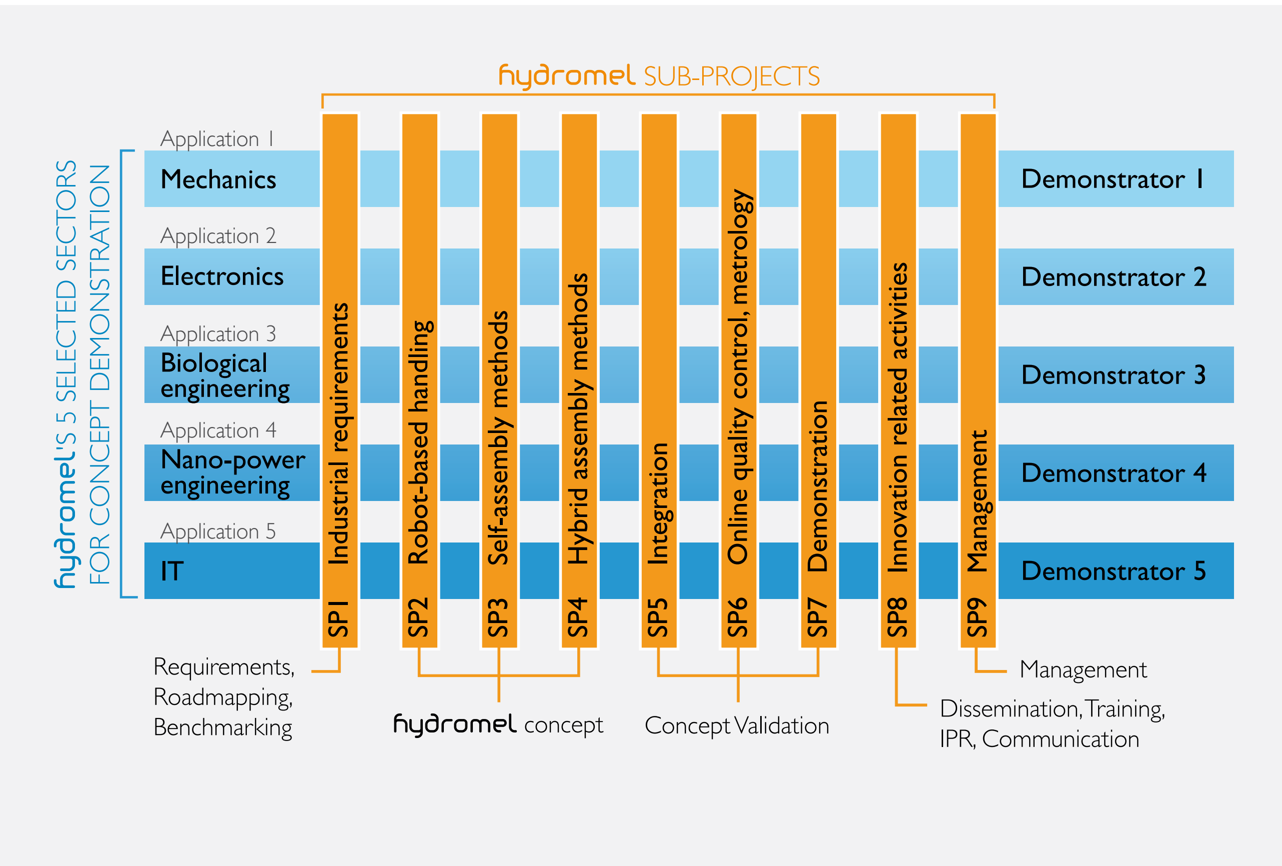
Scientific & Technical mid-term objectives:

- To create knowledge in **hybrid technology**: (i) to evaluate the compatibility of existing robots with self-assembly for the manufacturing of complex objects with micro- and nano-accuracy, and (ii) to develop methodologies for **robot assisted self-assembly and self-assembly assisted robots.**

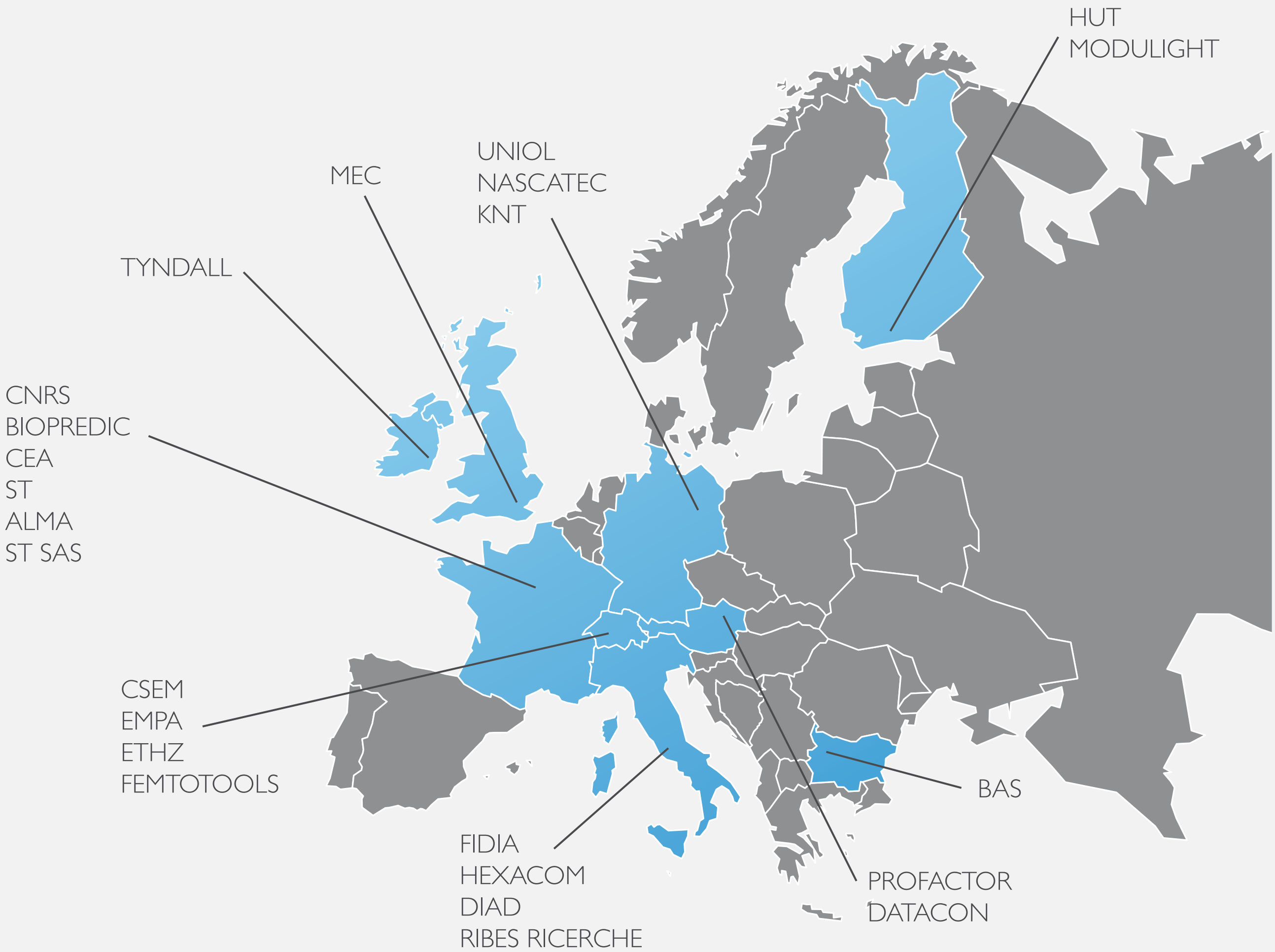
Scientific & Technical long-term objectives:

- To validate the transferability of the hybrid approach to the industry.
- To develop five industrially relevant new demonstrators. They will be developed with considerations for **flexibility** (5 different application sectors), **cost efficiency** (applicable to a large variety of materials, high yields), **positioning accuracy** (µm to nm range), **production rate** (simultaneous assembly of large number of parts will allow increasing of yields), **reliability and "measurement and control functions".**

Project Structure



Consortium



Acknowledgement

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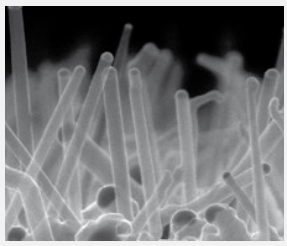
The Hydromel project addresses the area "Nanotechnologies and nano-sciences, knowledge-based multi-functional materials and new production processes and devices".

The project started on 1st of October 2006 and will last for 48 months.



Si Nanowires, courtesy of CEA-LITEN

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