Masmicro Newsletter

Issue 2 January 2006

Editorial

January 2006

Welcome to the second edition of the Masmicro newsletter, the result of a close collaboration with partners to inform SMEs, researchers, potential investors and users of the new production facility, about the progress of the project.

Launched in July 2004, Masmicro is an Integrated Project supported by the European Commission under the Framework Programme 6 (FP6).

With a total budget of €21.5 million, the four-year Masmicro project will develop an integrated production facility for the mass-manufacture of miniature and micro-products.

This edition reports progress made during the first year.

Dorothée Loziak

New laser system for material processing of micro-parts

Latronics GmbH based in Germany developed a new laser system within the Masmicro project. Hans Wilhelm tells us more about it.

What are the specifications of the laser system you created?

The whole system is a versatile tool for material processing of micro parts. The specificity of the system is the modular principle and the combination and synchronisation of scanning a laser beam with positioning the sample, both with high spatial resolution.

The system is set up as a 'stand alone' system for testing purposes within the Masmicro project and will be installed at the University of Applied Science in Cologne.

At the 'LASER 2005 - fair' in Munich in June 2005, there was interest in such a system from companies from the semiconductor industry and electronic industry. Most interesting for them was the combination of the movement of the laser beam in combination with the movement of the sample by a positioning system with high accuracy (< 1 µm resolution) and up to 6 degrees of freedom (movement in x, y, z - direction and 3 rotations around these axes).

Photo of the Masmicro laser system

How is it going to integrate into Masmicro?

It will be at the University of Applied Science in Cologne as a 'stand alone' unit for testing purposes (micro hydroforming and other potential applications). Such a system or a modified system could be integrated into a Masmicro production line.

Did you work on collaboration with other Masmicro partners to create the laser system?

We worked in close collaboration with professor Christoph Hartl from the University of Applied Science in Cologne. We also discussed about the system within our group RTD6, where also BPE International and the University of Strathclyde participated. The University of Applied Science in Cologne will present this system at the 'Hannover fair' in April next year.

What is your role within the project?

Our role within Masmicro is to provide a 'tool' for material processing, being adapted to the needs of the project. We don't do research and from my point of view Masmicro is both a research project as an engineering project. I would be glad if we can combine this system with a new application and integrate into a complete production system at the end of the project. This would be the real 'Masmicro breakthrough' concerning this system.

If you would like further information regarding this article, please email Hans Wilhelm at LatronicsGmbH@aol.com

Material Innovation and Testing Group

Ioannis S. Chronakis is the coordinator of the RTD 2 specialised in Material Innovation and Testing group. Based in Sweden at the Institute for Fibre and Polymer Research (IFP), he gives us an insight of the research provided by his European team.

What are the objectives of your RTD?

The objectives of the RTD2 can be summarised as follows:

1. Development of new material systems for miniature/micro-forming applications;

2. Development of flexible material-testing methods, procedures and testing devices;

3. Characterisation of materials/interfaces under complex conditions.

After one year of collaboration, what have you achieved?

Achieved results for the first year of our collaboration include, among others:

1. Identification of potential miniature/micro-materials and their processing for use in micro parts and micro parts production, and preparation of general considerations for developing a micro part.
2. Set-up and testing of electrospinning processing methods and technologies for micro and nano-shaping of both of polymer solutions and /or melts, and development of functional micro and nanofibers.
3. Development and study of new methods for testing micro materials, such as:

- Detailed classification of friction and lubrication fundamentals, including friction and wear measurement equipment;
- Nanoindentation experiments: first set of the materials data from the micro-tensile-testing;
- Methods and equipment for qualification of micro-interface heat-transfer phenomena in miniature/micro-materials;
- A 3D model of the concept of a micro-friction testing device.

What are you planning to achieve in the coming year?

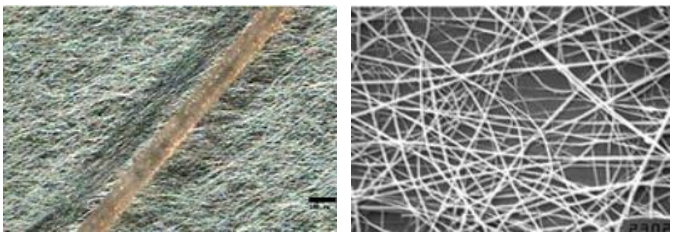
The next stage of RTD2 activities will be: further development of new testing equipment, testing-methods and procedures, and characterisation of new materials for miniature/micro-forming applications. It is also planned that RTD2 will continue to:

1. Provide consulting to partners related to different material problems for their tasks.
2. Provide materials data for design and analysis of new materials
3. Update the facility and the testing methods accordingly with material-testing requirements
4. Determine micro-materials and interfaces
5. Support forming-tools activities
6. Support the handling design and
7. Support the material-database input

How your results will integrate into the new mass-manufacturing facility?

One of the key issues concerning the miniature/micro-manufacture facility is to bring new knowledge on the development of new production-processes and new materials for micro parts, and apply the generated knowledge to the conversion of miniature/micro materials into engineering products.

The RDT2s' innovations will enable the realization of these aspects by carrying out fundamental research and bring new knowledge to develop a series of new materials and microtools, and the necessary methods and testing devices for the analysis of miniature/micro-forming materials.



SEM micrographs showing structures of nanofiber materials prepared from polymeric fluids by the electrospinning process.
(left) Polyethylene terephthalate) (PET) nanofibers - Comparison with human hair;
(right) Polyethylene oxide (PEO) nanofibers; the diameter of the fibers lies between 50 and 250 nm.

RTD 2 is composed of the following partners:

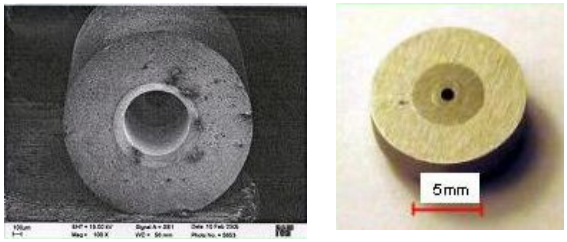
IFP Research AB (Sweden), EMPA (Switzerland) Tyndall (Ireland), Asociacion de la Industria Navarra (Spain), Institute for Product Development (Denmark) BPE International (Germany), Abbott Vascular Devices (Ireland), Pinol (Denmark), Pascoe (UK).

Forming tools and bulk forming machine

The Institute of Product Development (IPU) based in Denmark is involved in the production of a bulk-forming machine.

More precisely, IPU is in charge of realising a machine for bulk forming of metal components in the micrometer range, able to provide as well industrial manufacturing of tools for micro metal forming applications.

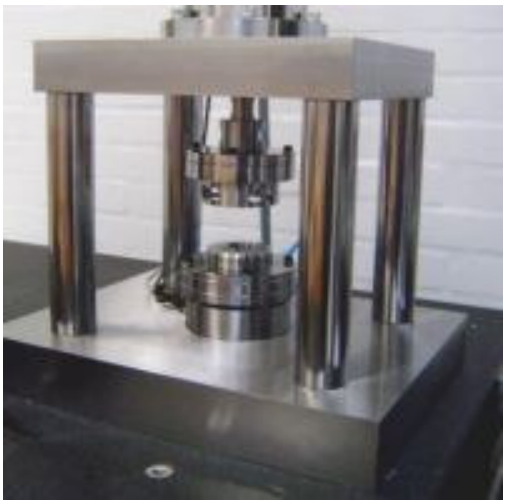
With its main operation in cold forging of parts, other production steps like handling will be taken into account. IPU is also considering tool life and coatings and tool materials to become important issues in the coming years.



Die and stress rings—manufactured by IPK, Institute for production systems and Design Technology.

So far, the team has carried out the following:

1. Initial trials has been carried out, on the manufacturing of forming tools by 3D micro EDM.
2. Design of a test rig for multi-stage cold forming, with intermediate high speed handling of parts between forming stations.
3. Design of research equipment for testing different gripper and transfer systems for components.
4. Handling principles for handling of components in industrial cold forming.
5. Design of the tools for manufacture of the 2nd cold-formed demonstrator in the Masmicro project. The demonstrator is an axle for a potentiometer provided by Pinol A/S.



The flexible tool system mounted in the press—manufactured by Pascoe and designed by IPU, Pascoe and Pinol.

Mogens Arentoft, coordinator of the RTD3 and 4, is planning the development within the bulk forming group in the coming year as such:

1. Manufacturing of the test rig for multi-stage cold forming including loading and un-loading stations and transfer systems.
2. Manufacturing of tools for the 2nd cold-formed demonstrator.
3. Conducting of research within the high speed handling of bulk micro components.
4. Design of process control for the multi-stage cold forming test rig
5. Conducting of research on accuracies, which can be obtained in cold forming of micro components.

Fundamental knowledge will be gained on the manufacture of tools for forming which will be used in all of the three forming machines. The cold forming test rig will be used to test the actuator and sensor technologies, which again will be used on all of three machines, while at the same time providing cold-formed components for the handling part of Masmicro.

Extrusion of components from 0 to 0.90 mm. The line below each component represents 1mm.

Masmicro 2004-2005
First year progress summary

The first period of the project (July 2004/ July 2005) saw the project development focused mostly on the fundamentals and new concepts concerning design, analysis, materials, testing, forming/machining tools and machines, handling, inspection, assembly, manufacturing control and integration.

The project has defined a theory for design and analysis of miniature/micro-materials and micro-forming processes, as well as the development of initial software modules. Miniature/micro-materials and interfaces were qualified through fundamental studies in miniature/micro-material properties, tool/material interfaces and testing methods, and development of the testing devices. Tool-design methodology, tool-manufacturing capability and constraints, tool-error analysis and error-compensation, tool-surface treatment, etc. were studied, based on which new conceptual designs of tools have been produced.

Process configurations have been qualified for micro-bulk-forming, micro-sheet forming and micro-hydroforming, as well as micro/nano-machining. Machine-realisation considerations have been examined intensively. Other developments included techniques for technology and equipment extension of non-traditional manufacturing for mass-production (Laser-equipment, Laser-forming, Photo-chemical-machining and forming and Micro-EDM). At the same time, methods for handling, assembly, testing and inspection, and corresponding software and hardware conceptual designs have also been developed. Manufacturing systems integration software development has also achieved significant progress with focus on the Knowledge-based decision support system and Manufacturing Execution System.

Main results to-date, which have shown potentials to the industry-applications, include a new theory based on the "Base underlying theory" and "Damage evolution theory" for the analysis of miniature/micro-materials, New CrN, CrAlN, WC:H PVD coatings and validation, In-situ micro-material testing procedure and nano-manipulation, Flexible micro-forming tool design, Piezo-actuator used as forced vibration source to assist in machining, Damping in air bearing systems - Air bearing slideways and rotary tables, "Customized" software for 3D- material processing (laser), Software for 6-axis motion system in combination with laser control, "Customized" laser-system for µ-material processing, Optical methods and the procedure for inspecting cylindrical micro-parts.

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FP6 Program

Masmicro Partners

1. University of Strathclyde (UK)
2. Abbott Vascular Devices (Ireland)
3. Centro de Ingenieria Avanzada de Superficies (Spain)
4. BPE International (Denmark)
5. Contour Fine Tooling Ltd (UK)
6. CEDRAT Technologies S.A. (France)
7. Gammastamp SpA (Italy)
8. Latronics GmbH (Germany)
9. Leister Technologies GmbH (Germany)
10. Loadpoint Ltd. (UK)
11. MASMEC s.r.l. (Italy)
12. Noliac (Denmark)
13. Pinol (Denmark)
14. Robotnik Automation S.L.L. (Spain)
15. Solas Data (Ireland)
16. Specicom (Belgium)
17. Pascoe Precision Engineering (UK)
18. Comtes FHT (Czech Republic)
19. Carinthian Tech Research AG (Austria)
20. Swiss Federal Laboratories for Materials Testing and Research (EMPA) (Switzerland)
21. Swedish Institute for Fibre and Polymer Research (Sweden)
22. Fraunhofer Institute Laser Technology (Germany)
23. Fraunhofer Institut Produktionstechnik und Automatisierung (Germany)
24. Fraunhofer Institute Production System and Design Technology (Germany)
25. Institute for Product Development (Denmark)
26. National Manufacturing Research Centre (Ireland)
27. Tekniker (Spain)
28. Upper Austrian Research GmbH (Austria)
29. University of Applied Science Cologne (Germany)
30. University of Birmingham (UK)
31. Leeds Metropolitan University (UK)
32. University of Patras (Greece)
33. Polytechnic University of Valencia (Spain)
34. Tecan (UK)
35. Anter Ltd (Greece)
36. National Metal Technology Centre (UK)

For a detailed presentation of each partner, visit

www.masmicro.net