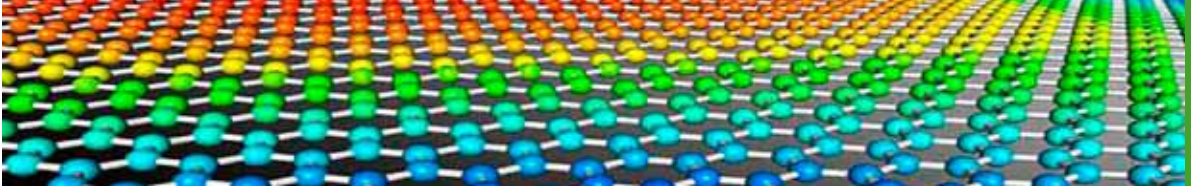

INSIDE THIS ISSUE!

MINAM
Micro- and NanoManufacturing

MNT FutureVision:

Mapping the future of Micro-, and Nano-Manufacturing in Europe

January 2012

A bulletin produced by the MINAM 2.0 project to support MINAM Technology Platform

MINAM 2.0

Paving the ground for the second generation of a highly effective, application oriented Micro-, Nano-Manufacturing community in Europe

MINAM specifically addressed new methodologies of Micro-, and Nano-Manufacturing Technologies (MNMT), their opportunities, user needs and technical challenges, which it tackled in its first Strategic Research Agenda in 2008. This has already initiated new collaborations between the micro-, nano-community and both the ICT and manufacturing industry across Europe.

With the goal to agree on and publish a new Strategic Research Agenda (SRA) for the European micro-, nano-manufacturing community in 2012, currently MINAM is supported and managed by MINAM 2.0 "Paving the ground for the second generation of a highly effective, application oriented Micro-, Nano-Manufacturing community in Europe", a Coordination and Support Action (CSA) under the Seventh Framework Programme of the European Commission.

Objectives

A key objective of MINAM is to identify emerging trends and provide strategic directions for future investment in research and development aimed at sustaining and further enhancing the leading positions of the European industry in micro-, and nano-manufacturing technologies. In particular MINAM addresses the strategic research priorities in four key areas:

1. manufacturing of nanomaterials
2. processing of nanosurfaces,
3. micromanufacturing processes
4. development of integrated systems and platforms for micro- and nanomanufacturing.

Today, the platform represents about 500 companies, research institutes and institutions concerning the businesses of micro and nano production. The following universities and national laboratories in the area of Micro-, and Nano-Manufaturing are contributing to the MINAM 2.0 project:

1. **Karlsruhe Institute for Technology (KIT, Germany)**
2. **Commissariat à l'énergie atomique et aux énergies alternatives (CEA, France)**
3. **University of Nottingham (United Kingdom)**
4. **Profactor GmbH (Austria)**
5. **Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. IPA (Germany)**
6. **Cardiff University (United Kingdom)**
7. **MicroTEC Südwest (MST BW, Germany)**
8. **Nederlandse Organisatie voor Toegepast Natuurwetenschappelijkonderzoek (TNO, Netherlands)**
9. **Plastipolis (France)**

MINAM Position Paper

available:

www.minamwebportal.eu

A first comprehensive and extensive summary of the 2011 survey findings had been released October 2011 helping to increase MINAM's visibility in the ongoing discussions along the preparation of Horizon2020. The MINAM 2011 survey had been conducted between January to March 2011 to

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MINAM 2.0

help MINAM 2.0 to identify the state of play. A representative set of organisations (regional clusters, ETPs and networks of excellence) had been selected. The figure shows the spread of members at each type of organisation showing a balanced share for SME´s, large companies and R&D institutions at the targeted organisations. The good mix of players confirms the new MINAM strategy to connect to network and cluster representatives acting on the one hand side as multiplicators and on the other hand side as a concentrator for ongoing MN related discussion within all groups involved.

Outlook

MINAM will continue to capture the needs of the Micro-, Nano-Manufacturing related community as well as to promote Micro-, Nano-Manufacturing to other interested communities. All people interested are welcome to join MINAM or discuss with us the future of MINAM.

In 2012 we will be present at the Micronarc Alpine meeting

www.mam2012.ch

and Hanover Fair 2012

www.hannovermesse.de.

Presentations and/or special sessions are planned at MicroNora Exhibition

www.micronora.com,

MM Live

www.micromanu.com,

COMS 2012

www.mancef.org/coms2012,

Industrial Technologies Conference

http://ec.europa.eu/research/industrial_technologies/index_en.cfm

and 4M

www. 4m-association.org/conference

and much more.

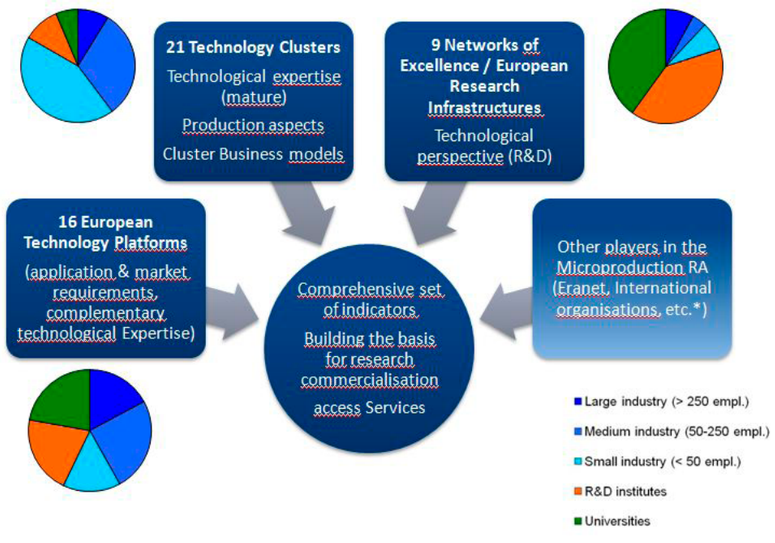
Thanks to the support by MINAM 2.0's group members: **Yi Qin** (Strathclyde, UK); **Christoph Hanisch** (FESTO, Germany); **Tullio Tolio** (ITIA, Italy); **Heinz Peter Hippler** (IVAM, Germany); **Patric Salomon** (4M2C, Germany); **Edward Byrne** (Micronarc, France); **Michel Carton** (CETIM, France); **Aleksandra Wisniewska** (EPPM, UK)].

The MINAM 2.0 will also work to broaden basis for its survey from now 50 organisations to other networks in similar production areas. In addition joint activities e.g. with the Smartframe network covering central European clusters, are being planned.

MINAM SURVEY 2012

available: http://www.minamwebportal.eu/index.php?m1=Public-Area&l1=MINAM-Survey-2011/2012

All players indirectly or directly involved in micro-, nano-manufacturing are invited to provide us with their feedback and/or their detailed view on the challenges the MicroNano community should face over the next years until 2020.



Nanodevice Project

The idea of NANODEVICE – a European FP7 funded project – is to develop Novel Concepts, Methods, and Technologies for the Production of Portable, Easy-to-Use Devices for the Measurement and Analysis of Airborne Engineered Nanoparticles in Workplace Air (www.nano-device.eu)

Due to their unique properties, engineered nanoparticles (ENP) are now used for a myriad of novel applications with great economic and technological importance. However, some of these properties, especially their surface reactivity, have raised health concerns, which have prompted scientists, regulators, and industry to seek consensus protocols for the safe production and us of the different forms of ENP.

What is the motivation behind this project?

There is currently a shortage of field-worthy, **cost-effective ways – especially in real time –** for reliable assessment of exposure levels to ENP in workplace air. In addition to the problems with the size distribution, a major uncertainty in the safety assessment of airborne ENP arises from the lack of knowledge of their physical and chemical properties, and the levels of exposure. A special challenge of ENP monitoring is to separate ubiquitous background nanoparticles from different sources from the ENP.

Figure 1: Personal sampler consisting of a personal sampling pump and a purpose-designed particle collector. *Source: Fraunhofer IPA*

To produce a portable, easy-to-use, on-line measuring device for workplace measurements.

Example: Nanofiber monitor

At present, nanofibre materials (e.g. carbon nano tubes, CNTs) in air can only be detected by deposition on a substrate and off-line imaging analysis such as TEM or SEM. The majority of techniques suitable for the quasi-real-time ENP measurement such as ELPI, SMPS, and CPC can not distinguish between nanoparticles in general and airborne nanofibres in particular. In common workplace settings the considerable background of fine and ultrafine particles thus poses a challenge for these instruments.

Furthermore, a true portability of the present devices is not given due to their size and power consumption. However, there is an urgent need due to the expected toxicity of nanofibres to control workplace environments with a robust and mobile device to ensure the safety of the working personnel as soon as possible.

To meet these challenges, a suitable personal sampler together with a corresponding reading device is under development in the NANODEVICE-project.

For personal particle sampling, a portable in-house developed device is used. It substantially comprises a suction pump, an air suction hose, an airtight closed housing with a slide-holder fixing a glass slide and an aerosol suction tube. This tube stands perpendicular on the glass slide. Through the aerosol suction tube, ambient air including particles is sucked in over a working shift period of eight hours, and the particles are deposited on the glass slide. A particle-specific shaped deposition pattern arises, which is analyzed by a light microscope. Because of the differences in size and electrostatic property between nanoparticles and background particles, it is assumed that there are differences in deposition pattern and place. A visual comparison of background and nanofiber measurements is made to get a qualitative conclusion. Shape-depended gray scale analysis and automated particle counting enables a quantitative distinction. Based on an eight hours measurement, it is assumed to have the possibility to give a statement about the nanofiber exposure at the workplace.

The main project goal is to develop innovative concepts and reliable methods for characterizing ENP in workplace air with novel, portable and easy-to-use devices suitable for workplaces.

Contact person:
Dipl.-Biol. (t.o.) Markus Keller Fraunhofer IPA
Ultraclean Technology and Micromanufacturing
Markus.keller@ipa.fraunhofer.de

Meet the whole Nanodevice Consortium at SENN2012 - International Congress on Safety of Engineered Nanoparticles and Nanotechnologies 28-31 October 2012, Marina Congress Centre, Helsinki, Finland

THE POLYTUBES PROJECT:

The overall objective of the EU FP7 POLYTUBES project is to develop a process chain and corresponding micro-manufacturing platform for the manufacture of polymeric micro-tubes and tubular micro-components for medical and non-medical applications. The proposed development aims to create a new market for EU SMEs with innovative and economically competitive micro-products and micro-manufacturing facilities to meet the needs for a wide range of emerging applications. The development will also support the SMEs to increase business opportunities with new volume production capabilities in micro-manufacturing. The proposed development could place EU in a pole position in the manufacture and innovative applications of tubular micro-products.

Precision Engineering and Micro-Manufacturing Research Group (PEMMRG) at the University of Strathclyde, UK

The PEMMRG has been involved in EU funded research for more than 20 years, including overall co-ordination of the EU FP6 flagship project MASMICRO ("Integration of Manufacturing Systems for the Mass Manufacture of Miniature/Micro-Products"). The group researches and develops processes, tools, machinery and numerical modelling techniques for improving economic and technical performances of material conversion technologies (Precision manufacture at macro-, meso-, micro-, and nano-length scales). The group's roles in the POLYTUBES project include "Technical co-ordination of the project", "Development of a new medical instrument for patch-clamp" and "Development of a process and the machine for hot-embossing of polymeric micro-tubes". To-date, a mass-producible process has been qualified and a novel, miniature, desktop hot-embossing machine and forming tools have been developed.

Needs of Shaping Micro-Tubes

As the trend of miniaturisation of various products, devices and equipment continues, demands on the complex micro-components increase significantly. The emerging needs include tubular micro-components (diameter < 1.0mm), such as that used in micro-medical-devices, micro-fluidic-devices and heat-management systems. However, shaping micro-tubes cannot be achieved simply by scaling down a large scale process and equipment to the micro-scale, due to many size-factors relating to the material, process, tool and machine to be considered. To address this issue, specific micro-shaping technologies, which are able to convert small tubes and thin sections into the required functional structures, and corresponding machine systems, which would enable a mass-production capability, will have to be developed. The hot-embossing process and the machine are one of the developments within the POLYTUBES project for the shaping of micro-tubes. Other developments include Laser-Drilling/Trimming, Blow Forming and Cross-Rolling of micro-tubes and the manufacturing platform.

The Hot Embossing Process

As a fabrication technique for creating micro-structures at the surfaces, hot-embossing often uses mould inserts for the forming/shaping of polymeric parts, which is similar to other replication techniques such as injection moulding and extrusion. Comparing to other processes, hot-embossing has merits of less system-complexity, shorter production cycle-time, lower processing temperature, etc. Nevertheless, the hot embossing process is often used for the moulding on the plain surfaces such as polymeric sheets and thin films or foils, to produce, mostly, 2.5D features. Hot-embossing of polymeric micro-tubes is to form 3D features (both outer and inner features), which requires more dedicated tool-design and process control, including considerations on the stiffness of tubular structures. Controlling of the formation of inner features is still of challenges, e.g. requiring more accurate definition of the process windows (related to the parameters such as material properties, temperature, holding time, pressure and handling of the tube/component).

Materials

A comprehensive review on materials was conducted in order to select appropriate materials for the hot-embossing process and applications (especially applications in the patch-clamp device). A series of material tests have been carried out to determine micro-tubes' mechanical properties, which generates the data required for process design and simulations. The variables and conditions considered in these tests included: (i). type of the material; (ii). diameter ratio of the tubes (OD/ID); (iii). deformation rate; and (iv). working temperature.

Tools

To enable high-quality hot-embossing of polymeric micro-tubes, tools are designed and constructed to enable: modular insertion of the core dies; precision guiding of the micro-tube inside the dies; heating and cooling units with a temperature control system; heat-insulation for an improved heating-efficiency; precise alignment of the upper and lower die-sets, etc. The tool design also took the requirement for automated handling into account.

Research in Hot-Embossing of Micro-Tubes

3D model of the machine and set-up

Contact person:
Professor Yi Qin
Design, Manufacture and Engineering Management
The University of Strathclyde
Glasgow G1 1XJ,
UK
Phone +44 (0)141 548 3031
Email: qin.yi@strath.ac.uk

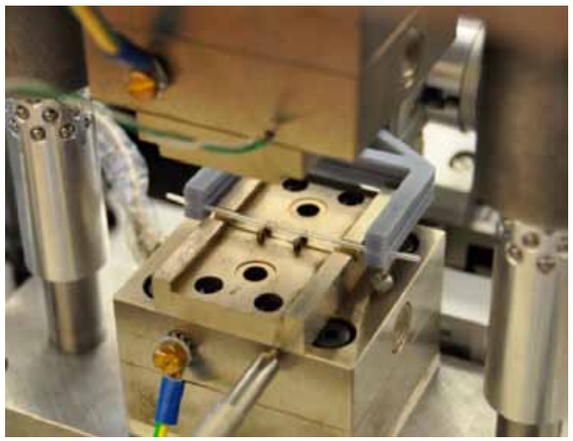
The Hot-Embossing Machine

The hot-embossing machine is a miniature desktop machine which integrates a linear press, forming dies and tool components with heating and cooling units, precision guides and machine frames, and an automated micro-tube handling system. To ensure a fully automated operation, a multi-axis micro-tube handling system has been developed as an automatic raw-material feeding and component pick-up device to serve the hot-embossing machine. The machine and process parameters such as press force, travel speed and distance, temperature as well as holding time can be easily changed with a software interface developed within the project. In summary, the system has the following features: integrated force, position and signal control; maximum force 3 KN; smallest force measuring 0.83 N; maximum stroke 100 mm; distance resolution: 0.049 μm; working temperature up to 500°C; 4 axis micro-tube handling unit; and a selection of the interface to PC.

Through a series of fine-tuning, the hot-embossing machine can now be fully automated and the results showed very good reliability and repeatability, hence, the process can be used for the mass-production of polymeric, tubular micro-components. The micro-tube handling system is also proved to work well and well synchronized with the press machine. Besides, very good material flow on the formed tubes was observed, especially when the working temperature is set up properly. It is showed that the shaping process and quality are influenced by the temperature, forming force and holding time significantly. More tests are being conducted to refine the process and the machine design in order to improve manufacturing efficiency and product quality. The machine is to be integrated into the manufacture platform being developed within the project. The aim is to integrate all processes/machines developed into a single platform for the manufacture of polymeric, tubular micro-components.

Other Applications

The low-cost machine system developed has potentials for a wide range of other applications, e.g. surface texturing on polymeric thin-films, glass, metals, composites, for the applications such as optical devices, micro-fluidic devices, etc.



Close view on the tool setup

Project and Cluster Presentations

MST BW, the clustermanagement of MicroTEC Südwest, is associated partner in the coordination action IRISS.

IRISS Implementation of Research and Innovation on Smart Systems Technologies

IRISS is dedicated to integrated Smart Systems, including micro-nano bio systems (MNBS) that often provide the key technical features for the competitiveness of products in many sectors. The objectives of IRISS are to hedge and extend competitive advantages of European industry in order to make Europe number one in the world in Smart Systems research and production. A special market focus of IRISS is on the medical and manufacturing sectors.

Therefore IRISS focuses on improvements of the European innovation system in the Smart Systems sector which comprises

the formulation of a coherent strategy involving all major stakeholders

- the opening of new application fields and markets
- the intensification of cooperations in the Smart Systems value chain, paying particular attention to the inclusion of SMEs
- the overcoming of fragmentation in the political landscape.

The innovation focus of IRISS is to identify, examine and recommend ways to gain a European advantage in smart, integrated products and systems, with an emphasis upon engaging with user communities – in particular:

- to establish applications-pull in a supply chain by engaging with user communities in fast-developing sectors, alerting them to the capabilities of Smart Systems and extracting their needs and ideas for introduction
- to examine and put forward cases for focused effort in the manufacturing sector and health sector, which both promise to provide hubs for coordinated activity, combined with world benchmarking and a survey of the longer-term technology landscape
- to draw together a network to support the implementation of its recommendations.

IRISS includes 26 organisations, of which 16 are contractual partners (from 8 EU countries) and 11 associated. It covers the whole value chain from researchers to end-users. In order to reach its objectives IRISS makes use of the EPoSS structures and builds upon the results of the CA CEPoSS.

IRISS
Implementation of Research & Innovation on Smart Systems Technologies

MicroTEC Südwest - The Cluster for Smart Solutions

The cluster brings together over 1,200 researchers from more than 350 companies, organizations, universities, and research institutes, making MicroTEC Südwest one of the largest technology Bosch, Roche Diagnostics, Festo, Daimler, Zeiss, Endress+Hauser, Sick, and Testo, networks in Europe. The aim of the stakeholders involved is to further develop the leading international position that the state of Baden-Württemberg already enjoys in the field of microtechnology into one of true global leadership. With major global players such as Bosch, Roche Diagnostics, Festo, Daimler, Zeiss, Endress+Hauser, Sick, and Testo —plus many innovative small- and medium-sized enterprises—the cutting edge cluster MicroTEC Südwest can provide a cross sector foundation for innovation and growth in the region.

Activities within the cluster are coordinated by MST BW—Mikrosystemtechnik Baden-Württemberg e.V., based in Freiburg. Charged by the Ministry of Economic Affairs of Baden-Württemberg with the management of the cluster MicroTEC Südwest, MST BW provides a central point of contact and represents the interests of its members in dealings with government and other institutions. Serving as an interface between science and industry, MST BW supports the use of microsystem technologies in industrial applications, research, teaching, and training, in addition to communicating the capabilities within Baden-Württemberg—alongside their national and international partners—in the field of micro-systems technology.

MINAM Participation at Euronanoforum in Budapest and COMS2011

MINAM Participation at Euronanoforum in Budapest

Euronanoforum 2011 (http://www.euronanoforum2011.eu/conference) was held in Budapest from May 30th till June 1st. At EuroNanoForum 2011 scientific, industrial and societal issues were discussed, including:

- Science and technology, highlighting world-class research
- Innovation and business, identifying nanotechnology opportunities and barriers throughout the value chain
- Society, taking a holistic approach to address societal benefits and risks

MINAM 2.0 (IPA, Profactor, UoN, KIT, CEA) was present with a booth in collaboration with the Hungarian Manufuture Platform. Additional to that presentations and posters related to MINAM 2.0 were presented.

MINAM Participation at COMS2011

COMS (http://www.mancef.org/coms2011) brings together leaders from all over the world and every sector of industry, all sharing, learning and creating partnerships in an open interactive setting. This is a powerful environment focused on accelerating commercialization activity among established and emerging micro and nano businesses. The Conference took place in Greensboro, North Carolina from August 28, 2011 -to 31, 2011. MINAM 2.0 was present on the booth of KIT with a Poster and Flyers and with direct contacts to the attendees of the Conference. MINAM 2.0 Members Markus Dickerhof (KIT), Svetan Ratchev (NoN) and Christian Wögerer (PROFACTOR) had several presentations during the Conference. Fruitful contacts were established (MICRONAC, Nanocom project a. Others) and project ideas for new projects discussed.

Nano S&T

BIT Life Sciences 1st Annual Nano-S&T-2011 (http://www.bitconferences.com/nano2011), held in World EXPO Center, Dalian, China ,from October 23-26, 2011 has gained great success. A lot of Keynote Speakers and Renowned Speakers from many countries attended this conference. MINAM 2.0 member Christian Wögerer (PROFACTOR) had the honour to chair a session related to the Topic of Nanomanufacturing, especially Nanoimprint technologies. In this presentation it was also possible to show some slides about MINAM 2.0 as THE platform for Micro- and Nanomanufacturing in Europe.

Manufuture 2011

Manufuture2011 (www.manufuture2011.eu) was organised within the official programme of the Polish Presidency of the EU Council. The focus of the conference was on how to ensure successful cooperation in High Added Value global manufacturing between EU countries and countries from Central and Eastern Europe as well as within the EU itself (between new and old member states). For the first time the ManuFuture conference will be organized in the country, which is placed in Central Europe and is recognized as new EU member state.

Minam 2.0 has organized a special session chaired by the European Commission with high level speakers from Industry (FESTO, MST BW e.V. / MicroTEC Südwest) and research (KIT, IPA, PROFACTOR, UoN). About 40 people joined the workshop and there was a fruitful discussion showing the importance of the Topic Micro- and Nanomanufacturing in Europe).

January 2012

IEEE MEMS

29 January to 2 February: Paris (FR)

www.mems2012.org

January 2012

Micronarc Alpine Meeting (MAM2012) – Equipment for Microproducts

22-25 January: Villars-sur-Ollon (CH)

www.mam2011.org

February 2012

IPAS 2012

12-15 February: Chamonix (FR)

www.ipas2012.org

Nanotech Japan 2012

15-17 February: Tokyo (JP)

www.nanotechexpo.jp/en/

March 2012

ICOMM 2012

12-14 March: Evanston (USA)

http://icomm2012.northwestern.edu/

NanoLive USA

7-8 March: Chicago (USA)

http://www.micromanu.com/x/mm-live-us/mmlive.html

Medtec

13-14 March: Stuttgart (DE)

www.medteceurope.com

MEMS Executive congress

20 March: Zurich (CH)

SSI Conference

21-22 March: Zurich (CH)

http://www.mesago.de/de/SSI/home.htm

April 2012

MACH 2012

16-20 April: Birmingham (UK)

http://www.machexhibition.com/page.cfm/ID=1

Hannover Messe

23-27 April: Hannover (DE)

www.hannovermesse.de

May 2012

Lausannetec

22-25 May: Lausanne (CH)

www.lausannetec.com

Clusterkonferenz of MicroTEC Südwest

14-15 May: Karlsruhe (DE)

http://microtec-suedwest.de/cms/front_content.php?idcat=101

Swiss Nano Convention

22 – 24 May: Lausanne, (CH)

http://swissnanoconvention2012.ch

June 2012

COMS 2012

24-28 June: Vestfold (NO)

EUSPEN

4-8 June: Stockholm (SW)

www.stockholm2012.euspen.eu

Industrial Technologies Conference

19 - 21 June: Aarhus (DK)

http://industrialtechnologies2012.eu

July 2012

CIRP ICME '12

18-20 July: Naples (IT)

http://www.icme.unina.it

July 2012

MedTechPharma

4-5 July: Nürnberg (DE)

www.medtech-pharma.de

9th International Conference on Nanosciences & Nanotechnologies (NN12)

3- 6 July: Thessaloniki, (GR)

http://www.nanotexnology.com/

September 2012

Micronora

25-28 September: Besançon (FR)

www.micronora.com

Micro and Nano Engineering MNE

16-20 September: Toulouse, (FR)

http://conf.laas.fr/MNE2012

October 2012

SENN2012 - International Congress on Safety of Engineered Nanoparticles and Nanotechnologies

October 28-31: Helsinki (FI)

http://www.ttl.fi/en/international/conferences/senn2012/Pages/default.aspx

4M 2012 Conference

09-11 October: Vienna (AT)

www.4m-association.org/conference/2012

The University of Strathclyde has supported the MINAM 2.0 Project by editing this newsletter. Editor-in-Chief: Yi Qin (University of Strathclyde, Email: qin.yi@strath.a.c.uk; Newsletter Design: Trademark(TM)Design (E-mail: trademarkdesign@virginmedia.com).