IFAM

# CELLMET NEWS

## Editorial

Dear reader,

Welcome in Montreal to the 5th International Conference on Porous Metals and Metallic Foams. The MetFoam 2007 in Canada will bring together the world wide community in cellular metals. This event will cover a wide span including the latest results in fundamental research of highly porous metals up to newest informations in their application.


In this CELLMET News issue you will find the latest results in aluminium foams (COMBAL metal foam, Advanced Pore Mophology [APM] aluminium foam, surface design of aluminium foam structures); informations about a new German network in cellular metals and an interesting application for open cell foams for ozone depletion. Additionally a short note about the application of molybdenum foams for high temperature thermal insulation and an open cell foam ring set as rotary oil mist separator will be addressed.

Günter Stephani, Fraunhofer IFAM Dresden

## CONTENTS



## inno.zellmet on the way to a successful project finish


Fig. 1 Metal hollow sphere encasement for high-speed milling tool (courtesy Portatec GmbH)

On the 4th of July, a public status seminar was held in Dresden where actual project results were presented to 50 participants from industry and academia. inno.zellmet is a large integrated project focusing on the commercialisation of specific types of cellular metals. It receives close to 4 mio. Euro in funding from the German Federal Ministry of Education and Research and the "Unternehmen Region" programme.

After a welcome note by Prof. Bernd Kieback, head of the Fraunhofer IFAM Dresden department, Wolfgang Hungerbach from Glatt GmbH gave an overview of the current inno.zellmet status. He pointed out that in the eyes of the project management, inno.zellmet has taken a very successful turn. Networking between the partners has reached a new quality which will result in the foundation of a registered non-profit association later this year to endorse continued cooperation between the members of the technology platform.

continued on page 2

Prof. Jörn Hübelt, director of Gesellschaft für Akustikforschung Dresden mbH, presented acoustic properties of metal hollow sphere structures obtained within the subproject MASCHA. Excellent results have been achieved for the acoustical encapsulation of a high-speed milling cutter. Replacing the massive encasement by a hollow sphere encasement (Fig. 1) resulted in a reduction in the sound level of 6 dB at a spindle rotational speed of 35,000 rpmin. An industrial workshop on new european sound emissions regulations and possible solutions especially with regard to small combustion engines has been organized by the inno.zellmet consortium and is to be held in Dresden on February 14th, 2008.

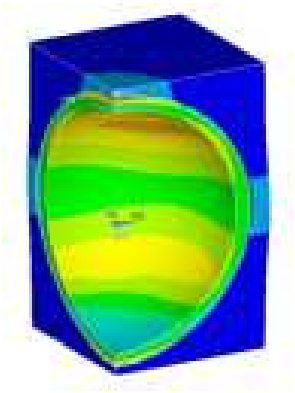


Fig.2 Visualisation of the compressive stresses and displacements of a metal hollow sphere embedded in a polymer concrete

Within the subproject MAKOMP, metal hollow sphere composites have been developed. This stiff and light-weight material will be applied in fast-moving machinery such as mirror sliding carriages and rotors. Martin Schöler reported on the work carried out at the University of Dresden with regard to the simulation of the mechanical behavior of parts consisting of the new material (Fig. 2). The ultimate goal is to come up with fast and reliable models that allow finite element calculations of actual parts.

Two inno.zellmet subprojects, CASMEDUM and HOTFAS, deal with metal fiber structures. Dr. Frank Engelmann, director of KEK GmbH, informed about the latest progress in explosion protection devices using this new material.

Fig.3 Protoypes of gas inlets for explosion proof gas sensors

Among other topics, a gas sensor with 20% shorter reaction time has been developed by utilizing the reduced pressure drop of sintered metal fiber structures (Fig. 3).

Another high-temperature application of sintered short fiber structures was presented by Dr. Andreas Gimsa, director of Enerlyt GmbH, Potsdam. Enerlyt develops a 4 cycle stirling engine for $\mu$CHP applications that runs with inno.zellmet regenerators. A regenerator is a highly porous structure that temporarily stores the heat of the working gas and releases it several hundred times per minute to cold gas. The efficiency and stability of the inno.zellmet regenerator was found to be very good and field testing will commence later this year.

Contact and more information:
www.innozellmet.de
olaf.andersen@ifam-dd.fraunhofer.de

## Environment well served with RECEMAT rotary oil mist separators

RECEMAT International has been selected as supplier for the metal foam elements of the rotary oil mist separator units being used for the breather units of the auxiliary gearbox of a new jet engine for a civil airplane. It has taken quite a number of years to prove the RECEMAT metal foams are the right materials for the job. The order that just recently has landed is the final proof of acceptance.

The objective of these units is to separate the liquid particles from the air. The cleaned air is discharged from the breather units into the air outside the aircraft. Conventional breather units would not be able to prevent a fair amount of oil mist to be transported out in to the atmosphere. Apart from the loss of a vast amount of lubrication oil through the breather, the discharged oil at the same time is polluting the environment.

continued on page 3

**Airplanes after taking off will climb for quite a while to altitudes of some 10 kilometres. During this part of the flight the pressure outside the aircraft is quite a bit lower than inside. The gearboxes too have to cope with the existing pressure differential. The gears in the gearboxes must be very well lubricated. Inside the gearboxes an intense mixing of oil and air is taking place. This is necessary to create superior lubrication of the mashing gear teeth. As a result inside the gearbox extremely dense oil mist is maintained. Under climbing conditions this oil mist stays under overpressure. In order to reduce the overpressure in the gearboxes they are equipped with so-called breather units.**

The novel rotary oil mist separators are equipped with a package of RECEMAT metal foam spinning assembly. The superfine oil particles contained in the mist hit the foam structure and then will flow along the metal structure, driven by the centrifugal force, to the outside diameter of the spinning rings. At the same time the air travels straight through the rings and out into the open air.

The present project will run for some 25 years. The pressure on all users of the environment to conserve our earth is ever increasing. Thefore the novel apparatus will become a necessity on all aircraft, whether they are new or old.

RECEMAT International supports its clients in research and development by funding their programs with material, manufactured products and/or engineering and consulting. In return RECEMAT International expects to receive the results. In this way RECEMAT international extends its knowledge and know how. Our support follows a special discount schedule and is limited to a maximum amount. This approach so far has resulted in a number of exciting uses of open cell metal foams. One of them is the Rotary Oil Mist Separator, an apparatus strongly assisting in conserving the environment.

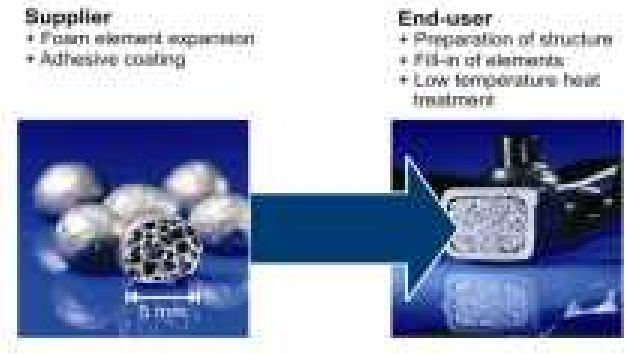
For further information, samples and literature, please feel free to contact Mr. Jan Leijenhorst or Mr. Henk A. Verduyn.

**RECEMAT**
open cell material engineering
INTERNATIONAL BV

P.O. Box 142
2920 AC Krimpen a/d IJssel
The Netherlands
phone : +31(0)180-315952
fax : +31(0)180-553351
website: www.recemat.com
e-mail : info@recemat.nl

## Simplified application of aluminium foam

Closed cell aluminium foams are mainly applied in hybrid structures as lightweight, stabilising, energy absorbing and/or vibration attenuating core material. These foam components are usually produced near net shape by forming the foam in the liquid phase during or directly after expansion within foaming moulds. Individually shaped parts require individual foaming moulds. Finally the foam components are integrated into hybrid structures (like e.g. locally foam filled A-pillar, see Cellmet News Nr. 1-2005) by adhesive bonding.




Fraunhofer IFAM in Bremen now offers a direct, simplified and more flexible process route for production of aluminium foam filled hybrid structures named Advanced Pore Morphology (APM) aluminium foam. The basic idea is to build the cellular metal component from numerous small volume, standard geometry aluminium foam elements which are poured directly into the later hybrid structure. The individual elements are joined by a thin adhesive coating on their surface. This directly after foam element expansion applied coating is non-tacky at

continued on page 4

room temperature and does not affect the pourability of the elements. During insertion of the elements into a cavity the bulk of foam elements is shaped by the inner contour of the structure. Individual foaming moulds are not required. By simple low temperature heat treatment (< 200°C) the adhesive coating is activated. Foam elements are joined to each other and to the inner surface of the hybrid structure via the activated adhesive coating.

The standardised geometry of the aluminium foam elements allows for automated mass production (foam expansion and adhesive coating) resulting in a significant cost reduction compared to other process routes. Further, end-users can apply APM aluminium foam and its unique property combination without sophisticated know-how about foam expansion. Supplied with a larger volume of bulk foam elements the end-user is free to produce any APM foam filled structure just by pouring in elements and performing the low temperature heat treatment for activation/curing of the foam elements adhesive bonding.

Contact and further information:
Dr.-Ing. Karsten Stöbener
Fraunhofer IFAM
Wiener Str. 12, 28213 Bremen, Germany
Phone +49-421-2246-117
stoebener@ifam.fraunhofer.de

## Aluminium foam for architects and shipbuilders

After having established the serial production of Aluminium Foam with a safety part in a German car in 2006 with an output of 100.000 pieces per year, Alulight is now looking into different application fields like architecture and shipbuilding.

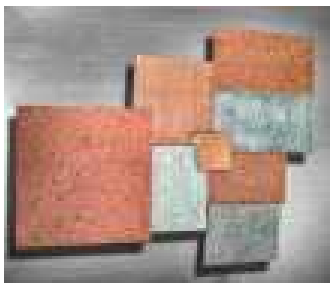
To attract the designers to the various looks of Aluminium Foam, Alulight has made several surface treatments on their typical 2 by 4 feet panels. Additional to the standard properties of low density, high relative mechanical properties and fire resistance, Alulight is emphasizing the sound absorption properties and of course the new technical looks.

For the production of these panels an infrared furnace was constructed in Ranshofen/Austria for maximum panel sizes of 3 by 4 feet and a thickness of 10 to 25 mm. For future projects in the North Americas it is planned to build up an automated and optimized version of this furnace on the Alulight of America premises in Delaware or South Carolina.

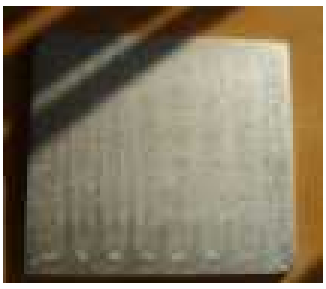
Further to these standard panels, Alulight is meanwhile also offering metallic bonded Al-Sandwichpanels (Al-6082 coversheet with Al-6005 core) in a maximum size of 4 by 8 feet. These panels are ideal for the use in construction, especially in shipbuilding, because of their light weight and sea water resistance. At the moment these sandwich panels are on the brink of certification by the American Bureau of Shipbuilding, which shall be finalized by the end of this year.

Peter Schäffler, Managing Director
Alulight International GmbH
5282 Ranshofen, Austria
Phone +43-7722-64564-0
Fax +43-7722-64564-610
www.alulight.com

Structure powder coated aluminium foam panels giving an impression of stone or forged metal with the low weight of aluminium foam



Alulight with a shining copper powder coating also available with a green copper patina



Sandblasted Alulight Panels providing a more shining and porous surface structure

Alulights sawed Panels showing a unique pore structure for decorative and acoustic applications. The colour is depending on the foam alloy

# COMBAL® metal foam - ready to go into production

**The new one step process for an economic aluminium foam production**

Being aware of the state-of-the-art processes for the fabrication of metallic foam parts, Degussa as the leading company in speciality chemicals and Bühler Druckguss as the front-runner in die casting machines fit into a joint-venture and developed a new patented one step process for an economic aluminium foam production - the so called COMBAL® process. The underlying idea of this process is to introduce Tego Magnan® magnesium hydride as solid blowing agent into the liquefied metal, directly.

After solidification in the die of a real time controlled machine the metal foam gained is a component with a near net shape geometry and with a closed, stable surface (see figure), and low density. Thereby, large scale series of construction parts even with complex geometries can be produced fast, economically and with a high accuracy. Counterfeiting mother natures principles for lightweight constructions, e.g. as being realized in a mammalian bone, COMBAL® foam parts are gradient materials with all immanent characteristics (see also table). Mechanical tests with a specific automotive part have shown 2-3 times higher resistance against torsion in comparison to a metal sheet design.

| Physical and mechanical properties, AlSi9Cu3 foam * | |
|---|---|
| average density (parts) [$\rho_B$] | 1.05 g·cm$^{-3}$ |
| average density foam [$\rho_f$] | 0.65 ± 0.05 g·cm$^{-3}$ |
| Young's modulus | 0.8-1.1 GPa |
| thermal conductivity [$\lambda$] | 3.5-4.5 W/m·K |
| energy absorption [$E_w$] | ≥ 0.3 MJ·m$^{-3}$ |
| compression strength [$-R_m$] | 17.5 – 21 MPa |
| compression yield stress [$-R_{p0.2}$] | 14 ± 2 MPa |
| specific heat [$c_p$] | 860 – 960 Jkg$^{-1}$K$^{-1}$ |
| thermal expansion coefficient [$\alpha$] | 20.2-22.10$^{-6}$ K$^{-1}$ |
| * all data measured at the Max-Planck-Institut für Eisenforschung GmbH Abteilung Werkstoffe, Prof. Frommeyer | |

For more information contact:

Dr. Bernhard Fritsche
Bühler Druckguss AG
CH-9240 Uzwil
bernhard.fritsche@buhlergroup.com

Dipl.-Ing. Ulrich Binder
Bühler Druckguss AG
9240 Uzwil, Switzerland
ulrich.binder@buhlergroup.com

Dr. Wilfried Knott
Goldschmidt GmbH
Goldschmidtstrasse 100
45127 Essen, Germany
wilfried.knott@degussa.com

# Ozone depletion by a catalyst based on open pore metal foam

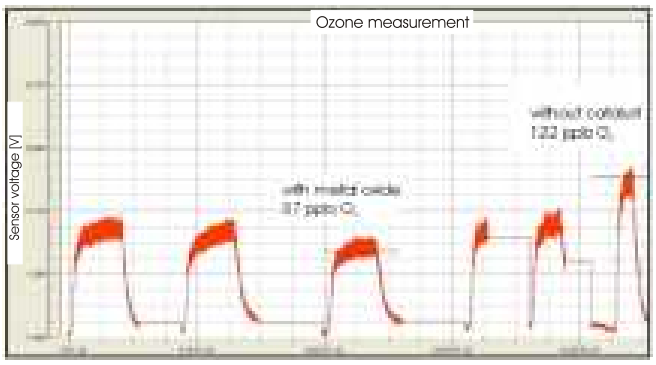
We are surrounded by air which is charged permanently by germs, dust and odour molecules. For the removal of the pollution, filters with adsorbing materials can be used. However, these must be cleaned regularly. In oxidising all organic components by ozone ($O_3$) and air humidity to $CO_2$ and $H_2O$ lies another option to get this result.

In modern airing systems the air is cleaned by application of ozone and is nearly free of smell, dust and germs. As well with the water treatment, ozone serves for the oxidation of metals, organic matters and for the sterilization. Hence, the treatment with $O_3$ belongs to the central steps of the water treatment.

Due to the very oxidising effect ozone is harmful for humans. The odour threshold is 40$\mu$g/m$^3$, from 200$\mu$g/m$^3$ symptoms appear and over 360$\mu$g/m$^3$ serious danger for the health exist.

The average half-life of $O_3$ is approx. 20min. By application in ventilation systems with a high aerial change rate a dangerous accumulation of the ozone

continued on page 6

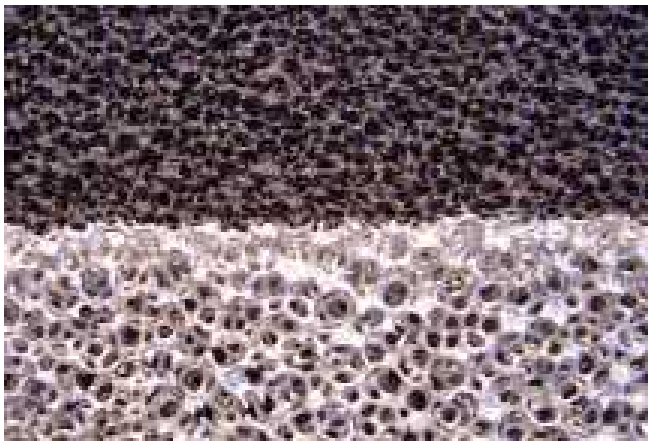



could happen. The measurements in a room with approx. 120m$^3$ showed this concentration effect with a small air-Ionisator.

To prevent this effect the ozone molecules have to be reduced especially by a catalyst. Open pore metal foams coated with special metal oxides can achieve this effect. To keep the pressure drop of the ventilation system low, a pore size of 4.5mm (10ppi) was choosen. With a metal foam height of 20mm, which reduces the concentration of $O_3$ to 50% of the input level, a pressure drop of $\Delta p = 5\ m^2/s^2$ is measured.

For more information contact:

Dr. Dieter Girlich, Director
m-pore GmbH
Enderstrasse 94 (G)
01277 Dresden, Germany
Phone: +49-351-250 2290
Fax: +49-351-250 2291
info@m-pore.de



## Book announcement: Aluminium Foam Handbook (in German)


A new pocket book about aluminium foam will be issued in German language by the end of this year. The aim of the authors Dr. Hipke, Fraunhofer IWU Chemnitz, Dr. Lange and Dr. Poss, Technical University of Clausthal was to prepare a comprehensive overview of aluminium foams. The book is divided into the following chapters:

manufacturing, structure, mechanical properties including fracture mechanics, joining, mechanical treatment, characterization, corrosion, construction, application, and future aspects.

**Taschenbuch für Aluminiumschäume**
Authors: Hipke, Lange and Poss
ISBN 978-3-87017-285-5

The book will be distributed by:
Aluminium Verlag
Postfach 10 12 62
40003 Düsseldorf
Germany
E-Mail: a.tappen@alu-verlag.de
www.alu-verlag.de

## Network “Cellular Metallic Materials” initiated

The Network "Cellular Metallic Materials" has started work at the beginning of the year. It is coordinated by the Fraunhofer Institute for Machine Tools and Forming Technology (IWU) in Chemnitz. Currently, 13 partners of industry and research have joined the network. The German Federal Ministry of Research and Technology supports the work of the network management in the context of the initiative "Netzwerkmanagement-Ost" (NEMO).

Booth of the network at the euroLITE from 25th to 28th June 2007

The network has emerged from the Association for Cellular Materials Saxony (VZWS), which existed since 2002. In the network, the work of the association is being continued and accelerated.

The network "Cellular Metallic Materials" concentrates the competences of companies and institutes that have the technological know-how for the development and manufacturing of cellular metallic materials made of various components available and want to use the potential of these materials. The activities of the network aim at publishing the various advantages of cellular metallic materials, the gaining market access and accelerating the development of new products as well as generating applications in series production.

The network focuses on realising these aims in the short term. Because of the close connection of research and development, production, manufacturing and application in the network, a proper basis for this purpose has been created.

For more information contact:

NEMO Netzwerkmanagement Ost

Cellular Metallic Materials

Dr.-Ing. Jörg Hohlfeld
Fraunhofer IWU
Reichenhainer Str. 88
09126 Chemnitz, Germany
Phone +49-371-53 97-14 96
Fax +49-371-53 97-14 47
Email: info@zellmetall.de
www.zellmetall.de

## “Time to be touched” using metal hollow spheres

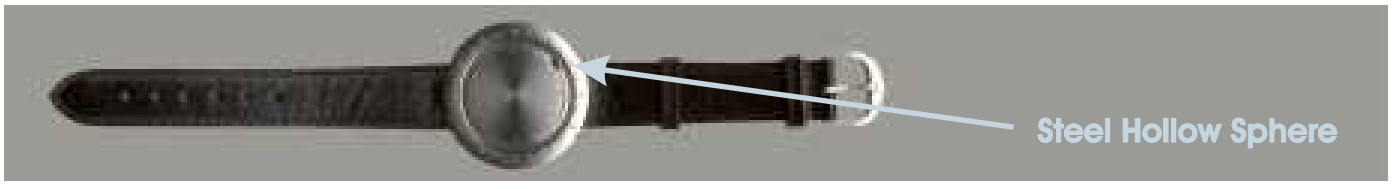
A new generation of wrist-watches has been created by the Erich Lacher Uhrenfabrik, Pforzheim, Germany. Time is “perceivable by touch” at last. No crystal and no visible hands. Only one stainless steel (410L) hollow sphere, which was developed by the Fraunhofer Institute for Manufacturing and Advanced Material (IFAM) Dresden, tells you the time. The grinded hollow sphere is freely movable and resets itself automatically to the exact time by using an ingenious magnetic system. A revolution as a tribute to unpretentiousness. In the center of the watch either company logos or other motifs can be engraved. The watch is available in gold, black or silver.

For further information contact:

Laco BY LACHER

Fraunhofer Institut Fertigungstechnik Materialforschung

Erich Lacher Uhrenfabrik GmbH & Co. KG
Rastatter Straße 8
75179 Pforzheim, Germany
Phone: +49-7231-1575-0
Fax: +49-7231-1575-11
E-Mail: h.guenther@laco.de



## 2nd CELLMET-Symposium in 2008

The second International Symposium on Cellular Metals for Structural and Functional Applications will be held September 25th to 27th, 2008 in Dresden, Germany. The aim of the symposium is to inform and discuss about actual applications and experiences made by end users. Furthermore, results from case studies, foam prototypes and demonstrators will be highlighted. In addition to classical metal cellular metals like foams, other highly porous metals such as honeycomb structures, fibre and wire structures, and other porous metals will be included. Further topics are joining, machining, coating and recycling of cellular metals.

An extended exhibition of cellular metals will be held in conjunction with the symposium. This forum should be used as a discussion panel between researchers, manufacturers and end users of cellular metals.

During the CELLMET symposium the first CELLMET awards will be launched. Two award categories (the application award and the demonstrator award) are granted.

The CELLMET 2008 is organized by the Fraunhofer Institute for Manufacturing and Advanced Materials (IFAM) and supported by German Society for Materials (DGM) and Materials Research Association, Dresden (MFD). The first announcement and call for papers will be issued in January 2007.

CELLMET 2008

For more information please contact:

Günter Stephani, Conference Chairman
Fraunhofer IFAM
Winterbergstrasse 28, 01277 Dresden, Germany
Tel. +49-351-2537-301
Fax +49-351-2537-399
guenter.stephani@ifam-dd.fraunhofer.de

## CELLMET-Awards for excellence in cellular metals

Cellular Metals have gained increasing interest in the last decade due to their unique combinations of properties like low weight, high specific stiffness, their energy absorption as well as their damping and insulating properties.

The CELLMET-Awards are granted to excellent results in the application of cellular metals. Two award categories will be launched:

- Award for a full serial part based on cellular metals (application award)
- Award for the development of prototypes / demonstrators based on cellular metals (demonstrator award)

Applications shall contain an explanatory statement of maximum 2 pages of the candidate. They should include evidence of:

- description of the metal foam part, technical data, field of application
- innovation compared to the state of the art, economical and ecological benefits
- number of parts per annum (application award)
- a foam part, foam prototype, demonstrator, has to be send to the judging committee

Selection and notification of the CELLMET awards will be made by the Award Committee consisting of international representatives of industrial and academia experts in the field of cellular metals. The first CELLMET Awards will be presented during the social event at the CELLMET Symposium, which will be held September 25th to 27th, 2008 at the Fraunhofer Centre Dresden, Germany.

The CELLMET Awards are sponsored by Alulight International GmbH, Austria and RECEMAT International BV, The Netherlands.

CELLMETAWARD

For more information please contact

Günter Stephani
Fraunhofer IFAM
Winterbergstrasse 28, 01277 Dresden, Germany
Tel. +49-351-2537-301
Fax +49-351-2537-399
guenter.stephani@ifam-dd.fraunhofer.de

CELLMET *NEWS* Impressum

Editors: **Günter Stephani**, Olaf Andersen, Hartmut Göhler - Fraunhofer IFAM Dresden, Winterbergstr. 28, 01277 Dresden, Germany
Phone: +49-351-2537-301, -300 - Fax: +49-351-2537-399
guenter.stephani@ifam-dd.fraunhofer.de - www.ifam-dd.fraunhofer.de

Presented by:

This issue was kindly supported by:

RECEMAT open cell material engineering INTERNATIONAL BV
P.O. Box 142
2920 AC Krimpen a/d IJssel
The Netherlands
phone : +31(0)180-315952
fax : +31(0)180-553351
website: www.recemat.com
e-mail : info@recemat.nl

Fraunhofer Institut Fertigungstechnik Materialforschung

CELLMETNEWS