

**DIRA-GREEN**  
X-RAY CONTROL TECHNOLOGY



Newsletter

[www.diragreen.eu](http://www.diragreen.eu)

Issue 11

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### Upcoming Meetings

#### Technical Meeting (M34)

**Date:** 10-18 July 2014

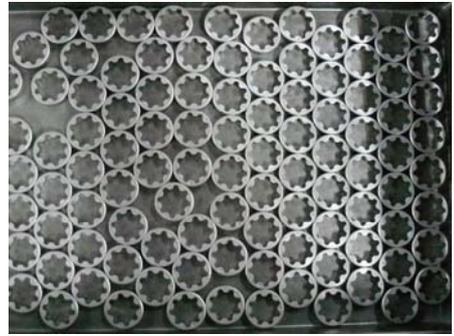
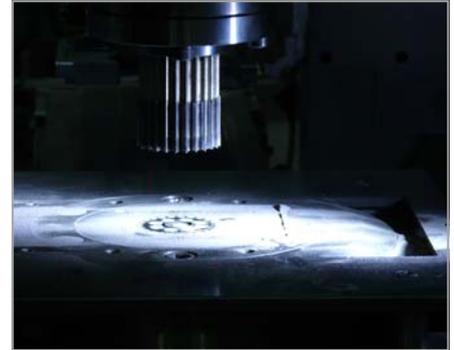
**Venue:** Istanbul, Turkey

#### Final Meeting (M36)

**Date:** 10-11 September 2014

**Venue:** Istanbul, Turkey

**THE AIM OF DIRA-GREEN** is to develop a new inspection tool for the improved assessment of green parts, which will prove affordable for SME's. Such tool will reduce the production costs and will decrease the amount of powder used to generate the same number of parts, owing the fact that the powder of the rejected parts can be re-used. The main outcome of the project will be the realisation of a Non-destructive Testing (NDT) technique, which enables online quality assurance of 'green parts', by monitoring compacted material porosity, and identifying microscopic cracks. This innovative tool will use digital radiography to create a density map for each component, indicating the size and location of defects. As the system will be directly integrated into the production line, it will be possible to identify faulty parts in real-time. Valuable data regarding part defects will be stored in a database, and used to improve mould/die design.



**POWDER METALLURGY** is the major manufacturing route for a wide range of industrial parts such as transmission and gearbox steel parts for automotive, cemented carbides and high speed steels for metal, wood or stone-working, magnets and soft magnetic materials, fine ceramics, refractory metals, bearings, etc. All these parts are produced by cold pressing a powder in a die and sintering the resulting green body in a furnace. A tool set for die pressing costs between 1.000 and 100.000 € The design of a tool set for a new product is made with a trial-and-error procedure that generates surplus costs (up to 50% of the initial tooling costs) and delays (several weeks or months). Furthermore, the optimization of the process is time consuming, due to the lack of fast and systematic systems instruments and procedures for the inspection of the material. In addition to the costs related to the development of the pressing tools, a major concern in powder metallurgy relies on the unpredictable formation of defects on the parts. While shrinking defects, and even surface cracks, are often detectable by inspection, internal defects are hard to detect. During the very early stage of compaction, the powder redistributes itself by flowing between sections of the die cavity. However, when the applied pressure is increased the powder movement gets restricted and shearing can occur unless the magnitude and the direction of the pressure are properly coordinated. Shearing can result in a density gradient within the parts. The density gradient is not always severe enough for an associated crack to form upon ejection. Unfortunately, nowadays there is no reliable method able to **inspect parts and detect local defects in green state powder metallurgy parts.**



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 286803.

## ● Nickel price soars amid export ban and sanctions fear

The price of nickel, a key alloying element in low alloy steels, stainless steels, high alloy steels and non-ferrous alloys, broke the US\$17,000/t barrier in early April, a rise of 16% since the start of 2014. The strong performance of the nickel price is forecast to continue as a result of reduced supply of nickel ore following an Indonesian ban on exports. Until this ban, Indonesia was the world's top high-grade nickel ore supplier.

According to a report from Standard Bank quoted in the Financial Times on April 10th, if the export ban remains in place beyond July's presidential election in Indonesia, the global nickel market will see significant deficits of 134,000 tonnes in 2015, 106,000 tonnes in 2016 and 77,000 tonnes in 2017. "In the absence of a change in Indonesian policy, we think that by 2016, the market will get tighter than in 2006-7, when prices traded in the \$30,000-\$50,000 a tonne range," the bank stated.

Potential sanctions by the EU and the US against Russia could impact on the supplies of nickel from Russia's Norilsk Nickel, a producer that accounts for 17% of the global nickel production. According to CEO of Norilsk Nickel, Vladimir Potanin, the company is considering measures to shield against possible sanctions from the US and EU by looking to Asia. "We have large volume of operations in the Chinese market, but the main payment currencies are dollar and euro. In principle, nobody hinders settlements in such currencies as the yuan for deliveries to China. We decided to explore this issue, to look how it'll function," Potanin told Russia Today.

Potanin stated, however, that he does not believe there will be tough sanctions as "they are unnecessary, uninteresting and harmful to both parties. But in a case of specific emotional actions of regulators or of certain countries - just in case - it is necessary to study what we will do in this situation."

Following previous nickel supply crises and price hikes, materials suppliers to the PM industry developed a number of low nickel containing steel powder materials that used alternative alloying elements such as manganese. Traditional PM steel compositions can utilise relatively high levels of molybdenum, nickel and copper to achieve medium to high mechanical properties in the as-sintered condition, however these alloys are sensitive to price instability.

Whilst low nickel containing powders and also copper-containing materials cannot be used as a direct substitute for alloys with higher nickel contents that are currently being used because of dimensional change and mechanical property requirements, their availability offers the PM industry a strategic opportunity to, for selected PM steel materials, move away from a dependency on nickel. The latest nickel supply and price issues could, therefore, again accelerate the trend towards leaner, more cost effective alloys, some being completely free of nickel.

Source: [www.ipmd.net](http://www.ipmd.net)

## ● Powder Technology course to take place at Lund University, Sweden ●

A new course on Powder Technology in Pharma, Food, Chemistry and Metallurgy is scheduled to take place at Sweden's Lund University, September 10-12, 2014. The three day course is aimed at industry professionals and Ph.D students and will include presentations from lecturers at Lund University and external speakers.

The aim of the course is to provide participants with a better understanding of powder products and processes and to supply tools to stimulate new ideas for development and improvement of powder products and processes. The course format also includes round table discussions focusing on specific themes such as rheology, powder characterization, granulation, agglomeration and processing of metal powders.

The first two days of the course will focus on particle properties and physical behaviour, measurements and definitions, properties of powder, definitions, important properties, what and how to influence powder properties, particle size enlargement, granulation, agglomeration and tableting.

The third day allows participants to choose between the following based on their area of interest:

Powder processing: fractionation, mixing, redispersion in liquid, conveying and storing or metallic powders and their applications.

For more information contact Mirka Fahlander at Lund University Commissioned Education, [mirka.fahlander@education.lu.se](mailto:mirka.fahlander@education.lu.se)

Source: [www.ipmd.net](http://www.ipmd.net)

## ● Update to Powder Metallurgy property database

The online Global Powder Metallurgy Property Database (GPMD) was launched in 2004 as a joint project between the European Powder Metallurgy Association (EPMA), Metal Powder Industries Federation (MPIF) and Japan Powder Metallurgy Association (JPMA).

Since its launch, the database has been refined and extended to include the non-ferrous Powder Metallurgy (PM) and Metal Injection Moulding (MIM) sectors with coverage of nearly 4,000 lines of high quality data.

Thanks to continuous growth the site now has over 10,000 registered users from countries all over the world and from a wide range of industrial sectors. In the latest development launched last week additional information has been added covering strain controlled fatigue data for:

- The pre-alloyed steel grade FL-05M1/FL-4405(0.85% Mo, 0.20% Mn, balance Fe) with a 0.5% elemental carbon addition, in both the as-sintered and quench and tempered conditions.
- The “hybrid” material FLN2-4405, based on same pre-alloyed steel grade, but with elemental additions of both 0.5% carbon and 2% nickel, in the as-sintered condition.
- The pre-alloyed steel grade FL-5305 (0.50% Mo, 0.20% Mn, 3.0% Cr, balance Fe) with a 0.5% elemental carbon addition, in the sinter-hardened and tempered condition

The data is displayed in a user-friendly format viewable in both tabular and graphic formats and it is hoped it will be of particular interest to design engineers in a range of industries.

Source: [www.ipmd.net](http://www.ipmd.net)

## Using MIM improves painting part ●

Paint and finishing specialist Hosco Fittings has designed a lighter-weight paint restrictor using a metal injection moulding (MIM) process.

The company says that the MIM design has improved the ergonomics of the spray gun and has less pressure drop/shear and precise application flow rates when compared to standard stainless steel paint restrictors.

In particular, a standard stainless steel paint restrictor’s weight can add to operator fatigue and some restrictors are not smooth bore and cavity free, which can result in pressure drops in the system as well as trapping paint in the cleaning process, ultimately resulting in dirty paint.

The 316 stainless steel Hosco HRU-6 has a 50% weight reduction over standard stainless steel restrictors and a smooth, curved interior radius which improves flow rates and minimises pressure loss and shear degradation of coatings, while maintaining peak transfer efficiency.

Source: [www.metal-powder.net](http://www.metal-powder.net)

## ● Proto Labs launches quick-turn MIM process

Prototype specialist Proto Labs Inc now offers metal injection moulded (MIM) parts as a standard option in its Protomold injection-moulding service.

The service makes it possible to produce metal injection moulded stainless steel parts available faster than ever before. The company also offers a liquid silicone rubber (LSR) moulding process.

"Over the past year, our research and development program has quickly advanced liquid silicone rubber moulding and metal injection moulding with the quality and quick turnaround that is the trademark of Proto Labs said Vicki Holt, President and CEO, Proto Labs. "Incorporating LSR and MIM into our existing list of materials allows current and future customers more diversity in prototyping and small-volume manufacturing."

Source: [www.metal-powder.net](http://www.metal-powder.net)

## ***LASER PHOTOTHERMAL NON-DESTRUCTIVE INSPECTION METHOD FOR HAIRLINE CRACK DETECTION IN UNSINTERED AUTOMOTIVE PARTS***

A statistical non-contacting and non-intrusive method for revealing the presence of cracks in un-sintered (green) parts manufactured by powder metallurgy (PM) technology was developed based on photo thermal radiometry (PTR). The technique relies on the interaction of a modulated laser generated thermal wave with the crack resulting in change of amplitude and phase of the detected signal. The crack existence at points in high stress regions of a group of green sprockets was evaluated through the proposed method. The results were validated by an independent destructive technique— microscope observation of the tested green sprockets following sintering, sectioning, and polishing at the locations where signal changes were observed in the green state. Statistical analysis confirmed the excellent sensitivity (91%) of the method in detecting the presence of hairline (5–10 mm) cracks. This PTR diagnostic technique may lead to a simple and reliable on-line inspection methodology in high-stress locations of PM manufactured industrial steel products. Ultimately, the method can be developed for non-destructive quality and feedback control of the metal forming process of green automotive parts.

[http://cadift.mie.utoronto.ca/Papers/NDTE\\_43\\_283a.pdf](http://cadift.mie.utoronto.ca/Papers/NDTE_43_283a.pdf)

## ***INFRA-RED AND ON-LINE TESTING OF GREEN-STATE AND SINTERED P/M PARTS FOR PROCESS CONTROL***

This research will concentrate on the formulation of a mathematical model capable of predicting the temperature distribution and heat flow in P/M parts and its relations to the supplied current, injection method, geometry and the thermo-physical properties of these parts. This model will subsequently be employed as a reference to aid in actual measurements of infrared signatures over the surface and its correlation to the detection of surface and subsurface flaws and inhomogeneity. In this progress report we will develop the theoretical background of IR testing of green state and sintered P/M compacts in terms of the governing equations, boundary conditions, and analytical and numerical solutions. Our main emphasis is placed on modeling various flaw sizes and orientations in an effort to determine flaw resolution limits as a function of minimum temperature distributions. Preliminary measurements have shown that this IR testing methodology can successfully test both green-state and sintered samples.

<http://www.wpi.edu/Images/CMS/MPI-PMRC/0302-1.pdf>

**DIRA-GREEN** will participate in the following event where you can meet with the developers and gather more information about our novel system.

## **Euro PM2014 Congress & Exhibition**

Europe's annual powder metallurgy congress and exhibition organised and sponsored by the **European Powder Metallurgy Association**, will make its return to Austria in 2014. The Euro PM2014 Congress and Exhibition will be held at the Messezentrum Salzburg in Salzburg, a UNESCO World Heritage Site, from 21 – 24 September 2014.

The combination of a world class technical programme and state-of-the-art exhibition will provide the ideal networking opportunity for suppliers, producers and end-users.

Euro PM2014 is an all topic powder metallurgy event featuring:

- Additive Manufacturing
- Hard Materials and Diamond Tools
- Hot Isostatic Pressing
- New Materials and Applications
- PM Structural Parts
- Powder Injection Moulding



<http://pm2014.epma.com>



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**University of Brunel—UBRUN**  
[www.brunel.ac.uk](http://www.brunel.ac.uk)



**Turkish Powder Metallurgy Association—TPMA**  
[www.turkishpm.org](http://www.turkishpm.org)



**European Powder Metallurgy Association – EPMA**  
[www.epma.com](http://www.epma.com)



**Associazione Italiana Prove non Distruttive—AIPnD**  
[www.aipnd.it](http://www.aipnd.it)



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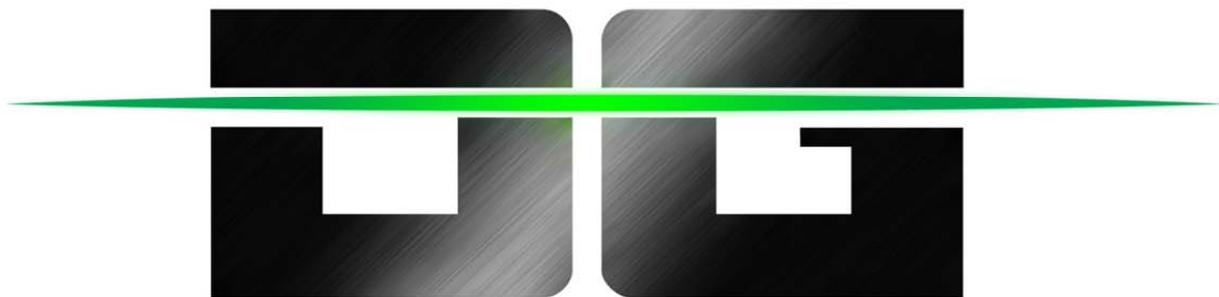
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