**INTRO FROM MARK DUDSON**
**BUSINESS MANAGER**

I, and everyone at Lucideon, hopes that you and your family are safe and well in these difficult times.

We thought we’d put together a newsletter to let you know what we’ve been working on in 2020 and what we have planned for the rest of the year.

Firstly, we’re happy to announce that we’ve joined forces with PCL Ceramics. The agreement will see us work together to provide an integrated and full service to the technical and traditional ceramics sectors, combining PCL Ceramics’ expertise in technical ceramics processing and engineering with our expertise in materials selection, development and characterization. You can read more about this on page 2.

In this issue, we also look at some of the projects where we’ve helped customers to solve materials and process challenges – one where we worked with Rolls Royce to understand the failure mechanisms of thermal barrier coatings and another where we helped a client to improve a coating process.

Solving insurmountable materials and process challenges is what we do here at Lucideon and is our key message as we’re out and about this year. Have a look at our stand for this year’s Ceramics Expo and Ceramics UK exhibitions on page 3 – hopefully, it conveys the sense of what we help you to do – overcome those day-to-day and long-term challenges.

One area that will become increasingly important to help us and you develop the products and processes of the future is AI. On page 4, Dr Richard Padbury, one of our senior materials consultants, tells us why data-driven approaches to materials and process challenges are a new tool for the material science field.

Our recruitment drive continues – Sandra Fisher John and Carolyn Grimley have joined us as materials scientists, supporting client projects around our proprietary Flash Sintering technology. Sandra will be based in the UK and Carolyn in Raleigh NC, part of our commitment to growing our technical ceramics offerings in the US. Find out more about them on page 4.

I hope you enjoy reading the newsletter. Please do let us know if there are any challenges that you’d like us to help you with.

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**The latest on…**

**ADDITIVE MANUFACTURING (AM)**

At Lucideon, we work with both manufacturers who are already using AM, as well as those who want to learn more about this revolutionary process.

Julius Bonini heads up our team of metal AM experts. From ensuring your feedstock is correct, to advising on the optimization of the sintering process and solving failures during manufacture and in use, they can help. Whether you’re working with metals, polymers, or ceramics our efforts wrap around answering three principal questions:

- How do you prove that product performance meets your design criteria?
- How can you ensure that you have consistent quality with an optimized process?
- How can you reduce risks while moving manufacturing to an AM process?

We have a large number of white papers and webinars on our website that are all free to download/watch, including:

- Additive Manufacturing of Ceramics
- Additive Manufacturing of Metallic Components - The Metallurgical Perspective
- Common Post-Processing Treatments for AM Components
- Ensuring Quality & Standardization in Powder Metal Input for AM

To view them, visit
www.lucideon.com/am

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**LUCIDION**
**Materials Development and Commercialization**

**THIS ISSUE**

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HELPING ROLLS ROYCE TO UNDERSTAND FAILURE MECHANISMS OF THERMAL BARRIER COATINGS

THE BACKGROUND
Ni-base superalloys, grown from single crystals, have been developed to meet stringent demands in the hot sections of modern gas turbine engines. These turbine blades require a thermal barrier coating (TBC) to provide adequate insulation. The TBC comprises an yttria-stabilised zirconia (YSZ) top coat and a Pt-diffused bond coat which aids adhesion of the YSZ to the superalloy substrate. Sulphur, which is present at low ppm levels in the Ni-base alloy, is known to segregate during thermal cycling and may accelerate cavity formation with the potential to compromise long-term engine performance.

THE CHALLENGE
Lucideon was approached by Rolls-Royce to assess quantitative changes in sulphur concentration across the microstructure of a turbine blade material which had been subjected to a series of treatments including high temperature ageing and oxidation cycles.

WHAT WE DELIVERED
Our world-renowned Surface Science team utilized its expertise in Secondary Ion Mass Spectrometry (SIMS) to develop a custom method to examine the in-depth distribution of sulphur and other key elements including Platinum, Chromium and Aluminium across the near-surface microstructure using cross-sectional imaging of the treated turbine blade materials. Retrospective linescans from the image data allowed quantitative comparison of the effects of treatments on sulphur segregation through the top coat/bond coat/substrate structure.

VALUE TO THE CLIENT
The SIMS method successfully monitored the in-depth distribution of key alloying elements and trace elements i.e. sulphur, within Ni-base superalloys. It clearly identified areas of sulphur partitioning within the structure and the effects of thermal cycling on this process. This study helped Rolls-Royce to increase its current understanding of sulphur’s role in the failure mechanisms of TBCs along with the potential to investigate ways to reduce failures in the TBC structure.

REFERENCES:
LUCIDEON ON SHOW
VISIT US VIRTUALLY AT CERAMICS EXPO AND CERAMICS UK

Ceramics Expo Connect (Virtual)
September 2020

Ceramics UK in Stoneleigh, Warwickshire, UK.
2-3 December (Stand A927)

INSURMOUNTABLE MATERIALS AND PROCESS CHALLENGES?

LUCIDEON can help
- Understand and source materials
- Optimize current products/processes
- Develop the next generation of products
- Implement new technologies
  - Solve failures
  - Improve yields
  - Reduce costs

So, if you have any challenges that you’re struggling with, please come along and let us know what they are.

Mark Crooks, our Commercial Manager is your first port-of-call at both shows. If you’d like to arrange a specific time to meet up with him, he can be contacted on
+44 (01782) 764246 mark.crooks@lucideon.com

Our experts will also be presenting at both shows

CeramicsExpo – ceramicsexpousa.com
Andy Perry, our Group Processes Leader, will be talking about ‘Learning from low margin/high volume production methods to improve efficiency’.

Dr Richard White, our Principal Consultant for Materials will be presenting on the ‘Development of alternative CMCs for advanced applications’.

Ceramics UK – ceramics-uk.com
Andy Perry will be talking in the ‘Disrupting the Production Timeline’ track.

Dr David Pearmain will be giving an update on our Flash Sintering technology platform.

IMPROVING A COATING PROCESS

“Our coating manufacturing process is very time-consuming and contains materials that are difficult to handle in terms of health and safety. Can Lucideon help?”

We identified a number of candidate material coating technologies - ceramic based alternatives that were suitable in terms of:
- coating performance
- suitability for substrate
- scalability to manufacture
- other benefits or drawbacks above and beyond current methodology

We also provided:
- manufacturing options
- initial material cost estimates
- general material sourcing
- market information
- perceived benefits or improvements to the current system.

VALUE TO THE CLIENT

Armed with our independent review of all coating technologies suitable for the application, the client was able to make a decision on the best way forward for their product.

The next steps for us are:
- source and performance test commercially available coatings
- process and material optimization
- scale-up to prototype.

GOT A CHALLENGE?

Contact us now to discuss
DATA-DRIVEN APPROACHES TO MATERIALS AND PROCESS CHALLENGES

Dr Richard Padbury, one of our senior materials consultants, tells us why data-driven approaches to materials and process challenges are a new tool for the material science field.

There is a long term need to discover new materials and processes to meet industrial demands. Why does it take so long, in some cases many decades, to develop these?

When new materials are being developed, we are up against a huge challenge: screening a vast material composition space in order to develop materials with properties dictated by structures over multiple length scales. Even when we have found that ‘needle-in-the-haystack,’ it can be difficult to produce the material repeatably and reliably at scale. Quite a task! That’s why we, and the materials science industry, are always looking for a more direct development pathway.

**How do we shorten development timeframes?**

Over the last 70 years, the convergence of higher computing power and high throughput simulation techniques has generated vast volumes of materials data. This resulted in a global effort to leverage data-driven techniques taken from the field of advanced analytics to find patterns and extract new knowledge from data with the goal of accelerating materials discovery. Literature is demonstrating that the application of data science, in combination with advanced computational chemistry techniques and physical experiments, could lead to disruptive decreases in development timeframes.

What we are really excited about is that these studies have opened up a much wider toolbox of techniques that can be tailored to develop solutions to a much broader range of immediate and long term materials development and process optimization challenges - such as, optimizing complex processes, improving quality and yield, reducing process failures and lead times and, of course, speeding up and derisking the development timeframe.

**How is Lucideon involved?**

We are teaming up with some of the world’s leading organizations to combine our materials science domain knowledge with expertise in high performance computing, high throughput simulations and advanced analytics in order to develop solutions to persistent challenges in the materials industry.

Have you seen our latest videos?

Andy Perry, our processes leader, is currently doing a series of videos on how to optimize your process. The first three have now been released:

- Understanding Rheology
- Understanding Particle Size Distribution
- Understanding Casting.

Check out the videos on our website at www.lucideon.com/videos

We’ll be posting more there soon.

www.lucideon.com
+44 (0)1782 764428 • enquiries@lucideon.com

NEW STARTERS

We’re strengthening our team both in the UK and the US.

**Sandra Fisher John**
DEVELOPMENT SCIENTIST

Sandra has a background in materials science and engineering with a focus on nanomaterials and composites (BASc - University of Toronto, MSc – Imperial College London). She combined these two interests during her PhD, where she focused on the development of new characterization techniques for particle dispersion in carbon nanotube and graphene composite materials. Sandra enjoyed the topic because it addressed a pressing need in the field: facilitating an in-depth understanding of the processing-structure-properties relationships which can, in turn, advance development and further the applications of these materials.

At Lucideon, Sandra will be working to support a number of client projects with a focus on Flash Sintering.

**Carolyn Grimley**
COMMERCIAL ENGINEER - CERAMICS

Carolyn holds a B.S. in Chemical Engineering, and has recently completed her PhD in Materials Science at North Carolina State University. Her dissertation focused on the flash sintering interplay of electric fields and microstructure that the technique involves. During both degrees, Carolyn worked as an Academic Researcher focusing on the processing and characterization of ceramics. Based in our Raleigh, NC, office, Carolyn will be supporting our US clients with their Flash Sintering and ceramics projects.