Diamond Composite press pack

Spokespeople

Mikael Schuisky, PHD

Job title: VP R&D and Operations, Sandvik Additive Manufacturing

Background: Dr. Mikael Schuisky, currently Vice President, R&D and Operations at Sandvik Additive Manufacturing, received his PhD in Inorganic Chemistry at Uppsala University, Sweden in 2000. During his PhD Mikael worked with thin film technologies like Atomic Layer Deposition and Chemical Vapor Deposition. He joined Sandvik in 2002 as a researcher working with large scale air to air PVD coatings of strip steel for applications such as bipolar plates for fuel cells. Since 2007 Mikael has held various R&D manager positions within the Sandvik Group, with focus on coating technologies. In 2014, Mikael took on the responsibility to build up the Additive Manufacturing Research Center at Sandvik.

Amelie Norrby

Job title: Additive Manufacturing Engineer

Background: Hailing from Sandviken, Sweden, Norrby has a master's degree in Technical Material Science from the Royal Institute of Technology.

Starting her career as an executive assistant at Sandvik Materials Technology, Norrby went on to work in division as a development engineer in the Tube Technology and Innovation department.

Now, Norrby is an additive manufacturing engineer at Additive Manufacturing, a division within Sandvik Machining Solution.

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Sandvik creates first 3D printed diamond composite

Sandvik Additive Manufacturing has created the first ever 3D printed diamond composite. While this diamond does not sparkle, it is perfect for a wide range of industrial uses. The new process means that this super-hard material can now be 3D printed in highly complex shapes and can thereby revolutionise the way industry uses the hardest natural material on the planet.

The diamond composite will be unveiled at the RAPID + TCT show in Detroit May 21 - 23, 2019, North America's leading event for Additive Manufacturing.

Diamond is harder than anything else in nature. It is a key component in a large range of wear resistant tools in industry, from mining and drilling to machining and also medical implants. Since 1953 it has been possible to produce synthetic diamond, but since it's so hard and complicated to machine, it is almost impossible to form complex shapes.

Until now, production of super hard diamond materials only has allowed for a few simple geometric configurations to be formed. By using additive manufacturing and a tailor-made, proprietary post-processing method, Sandvik has managed to 3D-print diamond composites which can be formed into almost any shape.

The difference between Sandvik's diamond and natural or synthetic diamond is that Sandvik's is a composite material. Most of the material is diamond, but to make it printable and dense it needs to be cemented in a very hard matrix material, keeping the most important physical properties of pure diamond.

The opportunities are enormous

Due to Sandvik's use of additive manufacturing, diamond components can now be created application ready, in very complex shapes, without the need for further machining. This will open up the possibility of using it in applications that were previously considered impossible.

"Historically, 3D printing in diamond was something that none of us imagined was achievable," explained Anders Ohlsson, Delivery Manager at Sandvik Additive Manufacturing. "Even now

we are just starting to grasp the possibilities and applications that this breakthrough could have.

“On seeing its potential, we began to wonder what else would be possible from 3D-printing complex shapes in a material that is three times stiffer than steel, with heat conductivity higher than copper, the thermal expansion close to Invar – and with a density close to aluminium. These benefits make us believe that you will see this diamond composite in new advanced industrial applications ranging from wear parts to space programs, in just a few years from now.”

The 3D printing process

“The additive manufacturing process used is highly advanced,” explained Mikael Schuisky, Head of R&D and Operations at Sandvik Additive Manufacturing. “We are printing in a slurry consisting of diamond powder and polymer using a method called stereolithography, where complex parts are produced, layer by layer, using ultraviolet light.
The step after the 3D-printing is however even more demanding. This is where Sandvik has developed, a tailor-made, proprietary post processing method making it possible to achieve the exact properties of the super-hard diamond composite.

“This step was extremely complicated. However, after extensive R&D efforts and several trials we managed to take control over the process and made the first 3D printed diamond composite.”

“It was incredible to see what we can achieve when we combine Sandvik’s leading expertise in materials technology with our strong capabilities in additive manufacturing and post processing,” commented Mikael Schuisky. “We have some of the world’s leading experts in both materials and additive manufacturing, which in a case like this can benefit many industries around the globe making it possible to use diamond in applications and shapes never conceived possible before.”

“Rather than looking to actually develop completely new materials, today the big push within the industry involves the often-radical restructuring of existing materials,” said Annika Borgenstam, Professor at the Department of Materials Science and Engineering at Stockholm’s KTH Royal Institute of Technology.

“Using revolutionary new processes such as additive manufacturing will open up completely new ways of using the same types of materials that we have today, by building in the properties that we need.”

“Sandvik’s 3D printed diamond composite is a true innovation. It means that we can begin to use diamond in applications and shapes never conceived possible before,” said Susanne Norgren, Adjunct Professor in Applied Materials Science at Uppsala University. “Just imagine what it could do to industries, when it is possible to print anything, in any shape – in diamond.”

Sustainable with superior properties

Another key advantage of additive manufacturing is that it allows engineers to minimize material waste, making the technology more sustainable. The diamond powder in Sandvik’s process can be extracted from the polymer in the slurry after the printing, and then be recycled and reused in another print-job.

The diamond composite has been tested and found to have extremely high hardness, exceptional heat conductivity, while also possessing low density, very good thermal expansion and fantastic corrosion resistance.

“We now have the ability to create strong diamond composites in very complex shapes through additive manufacturing, which fundamentally will change the way industries will be able to use this material. As of now, the only limit to how this super-hard material can be shaped and used is down to the designer’s imagination,” Mikael Schuisky concluded.

Fact sheet

- Diamond is harder than anything else in nature.
- Sandvik's 3D printed diamond composite was created using the additive manufacturing process called stereolithography, where complex parts are produced, layer by layer, using ultraviolet light.
- A slurry containing diamond powder and polymer is used in the process.
- After the printing, the next step in the process is even more demanding. This is the critical step where Sandvik has developed, a tailor-made, proprietary post processing method that is able to produce the exact properties of the diamond composite.
- Excess printing slurry can be reused to reduce waste – and the diamond powder can also be extracted from the slurry and then recycled, making the method more sustainable.
- Sandvik has a patent pending for the diamond composite process.

More information about the world's first printed diamond composite and Sandvik's capabilities in additive manufacturing can be found on Sandvik Additive Manufacturing's website www.additive.sandvik

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