



ULTIMATE SUPERMATERIAL

The Diversity of Diamonds

Contents

Introduction.....	3
Automotive.....	4
The Practicality Of PCBN.....	4
The Precision Of PCD.....	4
Aerospace.....	5
In The Sky With Diamonds.....	5
Healthcare.....	6
Consumer Goods.....	7
Speakers.....	7
Household.....	7
Construction & Stone.....	8
Optics & Thermal.....	9
The Benefits Of Synthetic Diamonds.....	10



Introduction

In this eBook we're going to explore the diversity of synthetic diamonds and find out why they are one of the most desirable and sought-after materials in the world. Regarded as the "Ultimate Supermaterial", synthetic diamonds are impressive even in tough environments. They are extremely effective for a wide range of industrial uses with their unique and abrasive, mechanical, optical, thermal and electrochemical properties. From car production and aerospace to healthcare and recycling, this eBook will shine the spotlight on the various functions of synthetic diamond and help you learn more about this marvellously adaptable material.

While you may be aware of the more conventional uses of diamonds in items such as jewellery, you may not be familiar with the other uses across the world in a host of applications, both in domestic and commercial sectors.

Lab-grown diamonds have the same chemical structures and physical properties as natural diamonds and both are made of the same material. The difference with lab-grown diamonds is that they can be optimised and tailored for a diversity of applications.

Join the conversation online using the hashtag **#UltimateSupermaterial**.

Automotive

Synthetic diamond materials are a major part of vehicle manufacturing. Each automotive component has requirements that demand a reliable production process.

While many think of diamonds as purely aesthetic, when it comes to the automotive industry they are used for much more. Synthetic diamond materials are used in critical engine and gearbox components, wheel assembly, window manufacture and the finish of smooth, sleek body panels to name just a few.

In comparison to more conventional tooling materials, supermaterials ensure a consistent production process in engine and powertrains globally, in both defined edge and abrasive applications. They also increase cutting and grinding speeds and extend tool lives, while lowering the total operational costs.



The Practicality Of PCBN

After diamond, Polycrystalline Cubic Boron Nitride (PCBN) is the second hardest material in the world and is used in different areas of the component production. PCBN is predominantly used in the finish machining of hardened steel and in the machining of grey cast iron brake discs.

A normal ceramic tool cutting edge can machine several hundred brake discs whereas a PCBN cutting edge can machine up to 10,000.



The Precision Of PCD

Although other diamond-based materials are commonly used within the automotive industry, Polycrystalline Diamond (PCD) is the optimal choice that delivers high precision and definition.

PCD materials are made up of microscopic diamond powders which are bonded through high pressure and temperature. They are actually the only material that can be used to finish the new generation of ceramic metal matrix composite brake discs effectively.

Aerospace

When it comes to building aircraft, manufacturers look for reduced weight and increased fuel economy. The latest generation is built primarily from Carbon Fibre Reinforced Plastic (CFRP) composites, which are lightweight and incredibly strong materials.

CFRP is ideal, but the challenge is in machining it. Drill bits laced with synthetic diamond cut through tough fibres cleanly, making short work of even the toughest materials.

Superior wear resistance and strong edge toughness make synthetic diamond the obvious choice for these demanding elements.

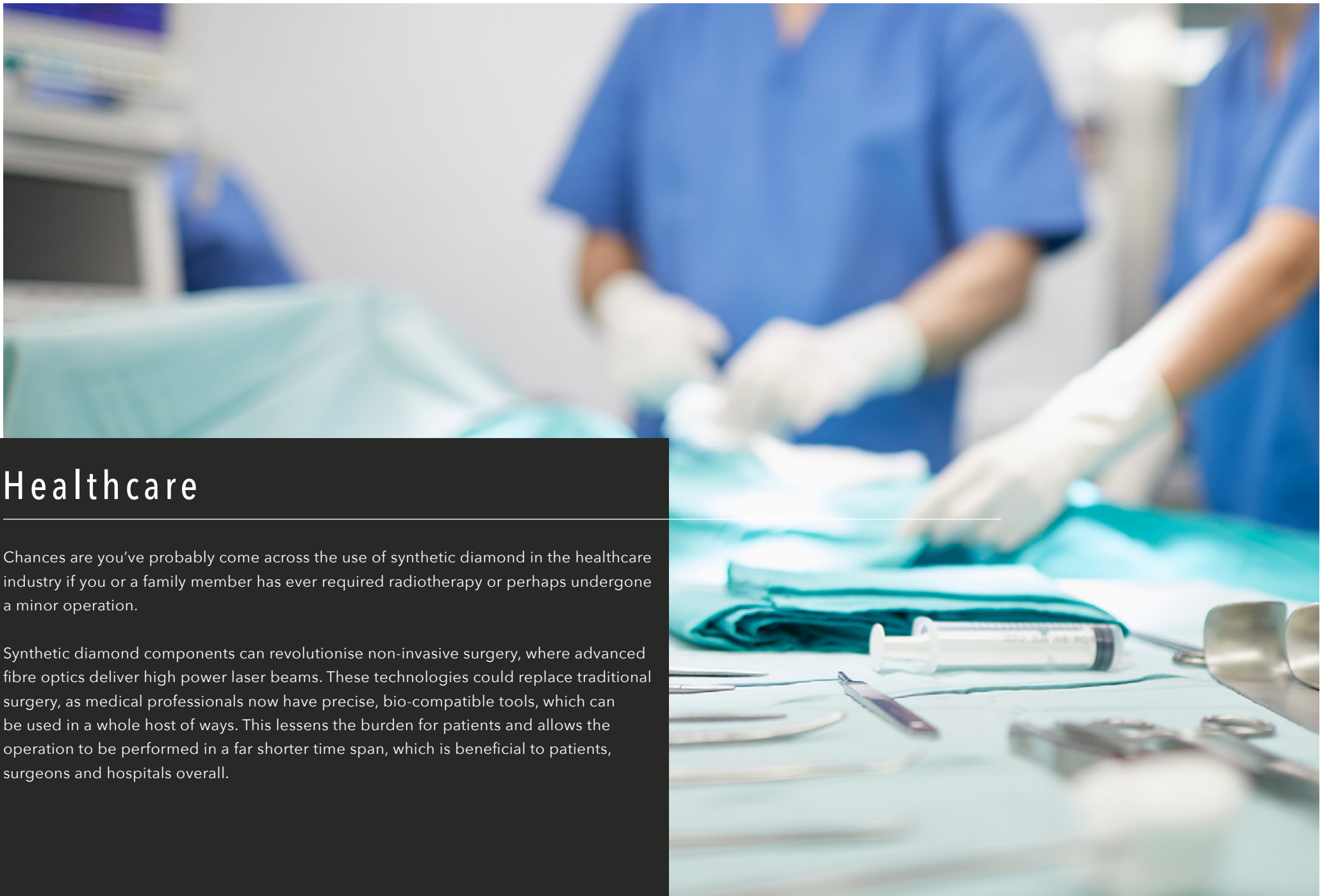
The use of supermaterials within the production, development and operation of modern-day aircraft means we are able to enjoy safer, more cost-effective flights as equipment becomes more reliable and precision becomes higher.



In The Sky With Diamonds

Industrial diamond is used to create robust tools for faster cutting speeds and improving operation. This is good news for airlines and passengers, saving them money and providing more reliable and efficient aircraft.

As new generations of aero-engines continue to swoop into the market, Polycrystalline Diamond (PCD) milling tools are predicted to overtake previous materials in production as they offer four times more productivity and tool lifespan. Although PCD tools are costly at the start, the savings in machine investment, depreciation and labour subsequently outweigh this.



Healthcare

Chances are you've probably come across the use of synthetic diamond in the healthcare industry if you or a family member has ever required radiotherapy or perhaps undergone a minor operation.

Synthetic diamond components can revolutionise non-invasive surgery, where advanced fibre optics deliver high power laser beams. These technologies could replace traditional surgery, as medical professionals now have precise, bio-compatible tools, which can be used in a whole host of ways. This lessens the burden for patients and allows the operation to be performed in a far shorter time span, which is beneficial to patients, surgeons and hospitals overall.

Consumer Goods

Although you may not realise it, synthetic diamonds can be utilised in a whole range of products that we use daily.

What does CVD stand for?

Chemical Vapour Deposition, and it explains the way in which the diamond is produced: via chemicals and gases.



Speakers

If you're a music fan, synthetic diamond can transform the quality of sound. The speakers that provide you with high-quality music when you need it could have been created using diamond technology.

A CVD diamond can be 'grown' into complex shapes offering a perfect combination of hardness and stiffness. A CVD diamond tweeter dome delivers supreme sound quality, all without a hint of distortion.



Household

Industrial diamond is most well known for its ability to drill or cut through almost anything. This means that the supermaterial delivers a precision finish to your furniture, as well as being used in electrical household items such as tablets and computers. The diamond material enables high precision production at increased speeds.

Construction & Stone

Our homes and buildings need to be made out of a hard, resistant material that can withstand water, strong winds, heat and anything else the weather throws at them. Tools made of synthetic diamond are ideal for cutting these hard materials.

These supermaterials are excellent at cutting, polishing and drilling, meaning they are a highly versatile material for use in construction.

If your kitchen has granite work surfaces, these will have been cut to size using a diamond saw. If you have slate slabs in your garden, these will also have been cut in the same way.



Optics & Thermal

The biggest cause of poor performance and device failure is heat. Industrial diamond has exceptional thermal conductivity. With the use of diamond heat spreaders, devices can operate more powerfully for longer and on a smaller scale.

Thermal management of electric devices is becoming more of a concern, as there is a need to increase power densities. The use of synthetic diamond helps lower device temperatures, which in turn improves performance and reliability.

A useful application of synthetic diamond is its delivery in high power laser optics. The supermaterial never needs replacing, ensuring consistent productivity and constant performance, minimising maintenance and downtime.

The use of synthetic diamond gives a lower running cost, and in comparison to other optical materials, gives a better performance to cost ratio.



The Benefits Of Synthetic Diamonds

There are many benefits to synthetic diamond in a variety of industries, some of which may have surprised you. Not only is it a more versatile choice of material compared to others, but it is more effective with its unique properties. From the cutting of material in the automotive and aerospace industries to assisting and advancing surgical procedures, it is likely you have benefitted from synthetic diamond technology without even being aware of it.

As we learn more about the incredible power of synthetic diamond, the use of these supermaterials is expected to increase in the future and soon we'll be asking how we ever lived without it. To summarise, here are the main benefits:

- Synthetic diamonds help revolutionise non-invasive surgery and allow operations to be performed in shorter time
- They can be utilised for a whole range of products such as high-quality speakers, tablets and computers
- They are used in powerful tools that enable faster cutting speeds to improve overall operation
- They deliver extremely long tool life, meaning reliable production and lower machine investment, depreciation and labour costs



Thank you for taking the time to read our eBook - we hope you've enjoyed learning more about the diversity of synthetic diamond.

Don't forget to share your thoughts with us using the hashtag **#ultimatesupermaterial** on Twitter and LinkedIn.

This eBook was brought to you with the support of Synthetic Diamond Supermaterials company, Element Six.

Sources

www.e6.com/en/Home

scienceviews.com/geology/diamond.html

www.sciencedirect.com/topics/materials-science/biocompatibility

www.novuslight.com/synthetic-diamond-in-optics-semiconductor-and-wastewater-markets_N5299.html