

Applications

Changing the face of medical with Lithoz 3D printed ceramics

Supporting the development of new ceramic AM applications in healthcare



3D printed ceramic implant designed by Netherlands-based Xilloc Medical and printed using Lithoz technology.²³

When discussing 3D printed ceramics, it is impossible not to mention Lithoz, one of the pioneers of the technology and an expert in ceramic AM materials. Based in Austria, Lithoz is actively involved in the development of ceramic additive manufacturing solutions for a range of industrial applications. Among the industries that Lithoz serves are the medical and dental sectors, which have both recognized the extensive benefits of ceramic 3D printing.

Ceramic 3D printing—and additive manufacturing more broadly—is gaining an increasingly relevant foothold in the medical and dental areas, and Lithoz says that more and more clients are adopting the technology not only for prototyping

but also for series production. That is, while many medical device manufacturers may have initially started using ceramic AM in a prototyping capacity, many are now transitioning into production after experiencing the performance and workflow benefits of the process.

As Lithoz explains: “We see that customers are now producing parts in lot sizes of up to ten thousand parts, which are not economically viable for injection molding.” In other words, ceramic AM is filling a void in the medical and dental sectors, enabling the production of small-to-medium sized runs of high quality ceramic products.

From surgical tools to implantable dental devices

In terms of properties, oxide ceramics such as alumina offer excellent strength and biocompatibility, as well as electrical insulation. Compared to traditional ceramic processing methods, additive manufacturing is enabling a higher degree of complexity, which is opening up a number of applications, including 3D printed minimally invasive tools, endoscopic tips and implantable electronic devices. These are often small and detailed components, which can benefit greatly from the advantages of design for AM (DfAM) as well as flexible production volumes and tool-free manufacturing.

In the dental industry, ceramic materials are already well established—in fact, ceramics have been used for dental applications for the past two centuries. Their prevalence in the sector is due primarily to the nature of

ceramics: they are biocompatible, incredibly strong and have a high degree of chemical stability. Ceramics are also suitable for dental applications from an aesthetic perspective: their appearance can be adapted to match the color and translucency of teeth.

In recent years, dental manufacturers have discovered the benefits of 3D printing ceramics, particularly zirconia and silicon nitride. Lithoz, which offers 3D printable versions of both technical ceramics, has supported the development of applications in the field with its materials and 3D printing technology. Among the applications that benefit from 3D printing today are 3D printed zirconia veneers and dental implants, like endosseous tooth implants which function as a foundation for replacing a missing tooth. 3D printing offers a particular advantage in the latter case, as it allows for precise surface structuring (i.e. roughness), which can increase the bonding between the implant and the bony tissue.

“Bioresorbable ceramics have the most similar chemical composition to human bone, making them the ‘gold standard’ for artificial bone substitutes”

The ‘gold standard’ for artificial bone replacement

On the medical side, Lithoz's 3D printed ceramics are proving to be suitable for a variety of applications. According to the company, as early as 2017 it had already seen at least 20 successful cranio-maxillofacial surgical procedures performed using implants printed by customers on its machines.

Driving these medical applications for 3D printed ceramics are a selection of materials that Lithoz has developed. For instance, the company has developed ceramic 3D printed bone substitute materials such as hydroxyapatite, tricalcium phosphate and mixtures, which can be used as a simpler alternative to autologous bone grafts (a complex process that entails surgically removing bone from the patient and grafting it where it is needed). In load-bearing applications, these materials can be used in combination with high-strength zirconia, which forms the exterior of the implant and provides support throughout the healing process. The interior of the implant is made from beta-tricalcium phosphate (β -TCP), or another bioresorbable ceramic, which stimulates bone growth.

“Bioresorbable ceramics are materials which have the most similar chemical composition to human bone, making them the ‘gold standard’ for artificial bone substitutes,” the company says. “Thanks to 3D printing and its design freedom, the material can be made into a structure that permits bone growth into the pores and channels. The material also undergoes biodegradation after its implantation, which allows for a regrowth of native tissue to be achieved without the need for removal of the implant after the healing process.”

Lithoz has also developed a number of non-bioresorbable ceramic materials for medical applications, including patient-specific cranial implants, finger implants and more. With its wealth of experience in ceramic AM and materials, Lithoz is an important partner to many medical device manufacturers. The company strives to work with members of the medical and dental fields to drive innovation and come up with new and innovative applications for its ceramic 3D printing materials and solutions. Overall, Lithoz aims to play an integral role in the adoption of ceramic AM in the medical sphere. ♦



Lithoz's 3D printed ceramics are suitable for a variety of medical applications, including jaw bone implants.²⁴