

Stereolithography Opens new Horizons for Technical Ceramics

3DCeram, a French high-tech company, has its headquarters on the Ester technopole, which is the ceramics competitiveness cluster of Limoges/FR. The company specializes in fast ceramic production (FCP) of technical components with complex geometry using laser stereolithography.

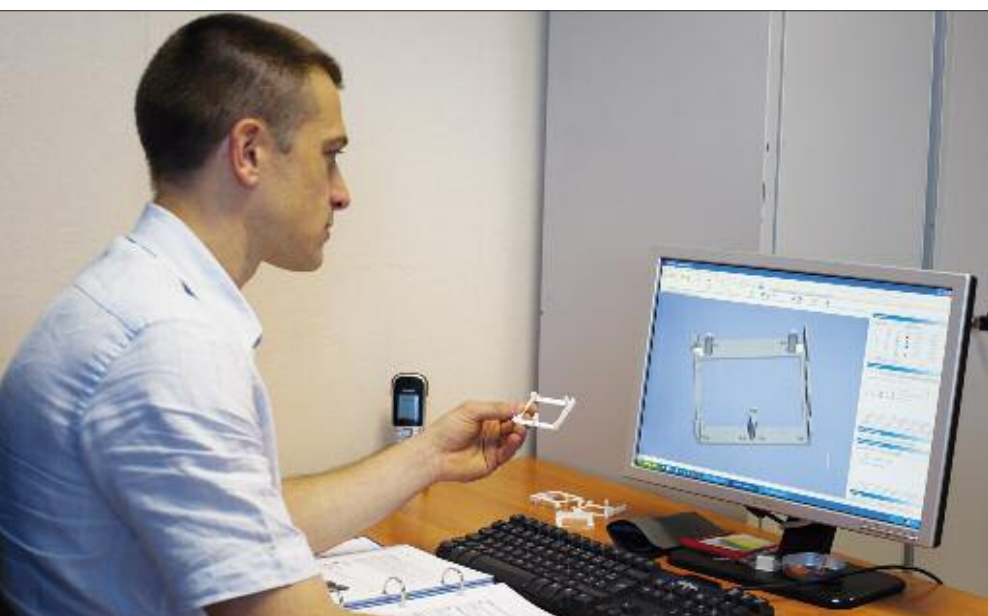


Fig. 1
CAD file preparation

The technical ceramics market is constantly evolving and asks for more and more performances. 3DCeram innovates and enables its customers to explore the numerous possibilities offered by this group of materials. The company is ISO 9001 and ISO 13485 certified and offers turnkey solutions for the production of ceramic components. The expertise of its employees, its unique know-how of the stereolithography technology (3D printing)

Keywords

Stereolithography, white light 3D scanner, fast ceramic production (FCP), bioceramics, luxury and general industry applications

applied to ceramics and its industrial equipment (white light 3D scanner, stereolithography machines and facilities) allow it to position itself as an industrial partner who is able to assist its customers in their product development strategy (Fig. 2). The company offers them a full range of services aiming to manufacture ready for use high performance ceramic components: consulting services, co-development of ceramic components and turnkey production solutions while respecting the technical requirements of the most demanding specifications, even within shortest lead times. This offer strongly helped the internationalization of 3DCeram on its key markets (bioceramics, luxury and industry).

Stereolithography – an innovative technology

Demands of customers who need to produce a unique object or small series of ceramic components within a very short time limit cannot be satisfied with traditional shaping methods such as injection, pressing or casting. These processes are not suitable for reasons of tooling costs or lack of flexibility owing to the volumes and geometries of components to produce. Injection moulding is widely used in the plastics industry to produce complex and intricate components – the CIM-technique makes this approach possible for ceramics.

3DCeram uses a unique technology: laser stereolithography applied to ceramics. It is used for the Fast Ceramic Production (FCP) and allows manufacturing components in layers from a CAD file (Fig. 1). CAD data is first exported in STL format. To allow the object to be manufactured, a software creates the necessary supports for the overhanging layers. A slicing software is then used to define all the layers to be made. Each layer of paste, made up of photosensitive resin and ceramic, is polymerised by the laser with extreme accuracy. Parts are then cleaned and heat treated in order to eliminate the resin and densify the ceramic to 100%. The produced parts can have a very simple geometry or, on the contrary, be extremely complex.

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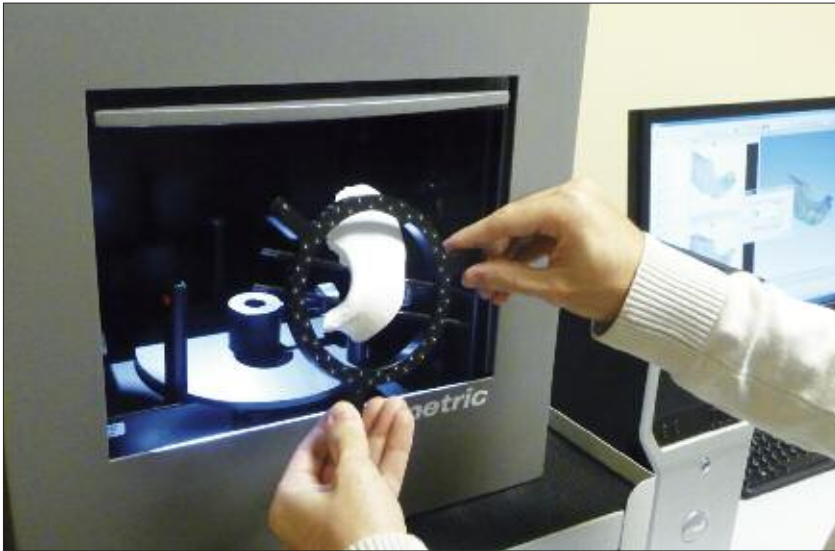


Fig. 2
White light 3D scanner

The process generates no break in the digital design. Technical and aesthetic options and finishes (shape, touch and texture) are verified and controlled on an object whose quality is the same as that of the final object. The component produced is a functional object whose material has physical and chemical properties comparable to those obtained with conventional manufacturing methods. This object therefore possesses the same qualities as the standard part and can actually be tested in real working conditions. With this

technology, customers can test a new product they want to develop and produce while saving the tool adjustment time which simply cannot be suppressed if the project is entrusted to machinists or injection experts. The development and production cycles of a product are down from 2 or 3 months to a fortnight. Customers can be offered an alternative ceramic solution with very advantageous intrinsic properties compared to other competing materials such as metal or plastic, for example.



Fig. 3
Bone substitute manufactured directly from a CAD-file

Applications – excellence is the common feature

This technological breakthrough opens up new application areas for ceramics. Ceramics may be preferred to other competing materials and it can win new market shares in the biomedical, luxury goods and industrial sectors, for example. Many companies have already trusted 3DCeram to supply them with a solution to their problems which is both reliable and manufactured at industrial scale and guarantee as well the quality of their product.

When applied to the biomedical market, the FCP technology allows designing ocular implants, bone substitutes or tailor-made ceramic cranial implants. Their exceptional biocompatibility, their extremely regular porous structure and mechanical strength are the main qualities of these bioceramics. A bone substitute can be produced with a porous structure which is directly controlled from a CAD file and made of biocompatible materials such as hydroxyapatite (HA) or tricalcium phosphate (TCP), according to the final application while fully respecting the surgeon's specific recommendations. The material is completely biocompatible and complies with the ISO 13485 standard for long-term implantations. For a given porosity value (60 %), the mechanical strength is 3 to 5 times higher. All pores have the same diameter and help improve the development of the osteoblast. It is possible to have a porous and dense area on the same part. Bone substitutes are manufactured directly from a CAD file, there is no limitation in the design and each implant can be customized for each patient. The use of an FCP implant allows the surgeon to create the best free form and guarantees a quick delivery (15 days for the first parts).

Renowned watch makers and jewellers already trust FCP technology

The design freedom and unparalleled precision associated with high production quality very quickly interested the luxury industry, particularly the manufacturers of high end jewelry. The technical performances of ceramics are attractive: ceramics has a silky touch, it is unalterable and hypoallergenic. Its strength is high and even superior to most surface treatments currently available on the market. Its resemblance to onyx or mother-of-pearl, de-



*Fig. 4
Implant trial before surgery*



*Fig. 5
Ocular implant cleaning*

pending on the body coloration, also quickly attracted the interest of famous fashion houses. When applied to ceramics, stereolithography allows avoiding making a mould and a designer may consider even very complex shapes. He can imagine, create, and see the fruit of his imagination placed before his very own eyes three weeks later. This represents a significant advantage in terms of responsiveness for the creation & design department of a jeweller. 3DCeram already offers

a large pigment range to colour ceramic parts and is actively expanding it to fulfil the demands of these sectors that have very high aesthetic and quality expectations. In addition, the on-demand FCP production department can shape unique art pieces or numerous unique pieces in one series without minimum quantity and it also offers tailor-made finishes. Industry leaders have already been convinced by this new technology too. *Barco*, one of the leaders in the development and

manufacture of widescreen video systems and graphic devices for screens had a focusing problem with one of its video projectors owing to a metal attachment lug which was not robust enough. 3DCeram supplied the company with a custom-made solution by shaping a mounting housing in alumina with the FCP technology. This exemplifies how, against all odds, the relevance of using technical ceramics can become evidence thanks to stereolithography.



*Fig. 6
Jewelry – ceramic watch box*



*Fig. 7
Roses – full ceramic ring*