



# First Steps in Additive Manufacturing: What is Possible?

3D printing is a trend. At Formnext 2019, numerous young and established companies presented their manufacturing technologies to those who already use the technology but also to those who want to get started. What newcomers need to keep in mind is explained by Nicolas Rousselet from 3DCeram and Prof. Dr. Kollenberg from WZR ceramic solutions.

The number of visitors at Formnext 2019 shows a trend that will probably not come as a surprise to anyone: Additive manufacturing has arrived in the industry. The trade fair has only been around since 2015 and the organizer Mesago Messe Frankfurt has enjoyed increasing interest every year since then. 34,532 visitors came to Frankfurt last year, compared to 26,919 in 2018, and the number of exhibitors has also risen from 623 to 852 since 2018 [1].

And this is no longer just about 3D printing with plastics or metals. Additive manufacturing with ceramics is also becoming increasingly important for the aerospace, automotive, marine, energy, electronics and medical industries. By 2018, worldwide sales of ceramic 3D printing are estimated to have reached 98 million US dollars. Forecasts by the American research company Smartech Publishing indicate that it will increase to 3.6 billion US dollars by 2028. If the development of ceramic 3D printing follows that of additive metal manufacturing, the technology will make a major breakthrough in 2025 and establish itself as a manufacturing technology in various industries [2].

## New guideline supports product developers

As a result, many newcomers are currently pouring onto the market who have not previously explored the advantages of additive manufacturing or of ceramic materials. The VDI – the Association of German Engineers, for example, has therefore recently published a new guideline that provides basic knowledge in this area and gives specific design recommendations for additive manufacturing of ceramic components. The guideline does not require any in-depth prior knowledge in the field of ceramic production or 3D printing [3].

Used correctly, this technology can offer enormous advantages for the users and open up new possibilities. The fact that new users are successful with additive manufacturing is also in the interest of manufacturers and producers. We asked two of them how they best support their new customers in getting started. ◀

## References

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- [2] 3Dnatives: „3D-Keramikdruck – ein rasend wachsender Markt“. <https://www.3dnatives.com/de/3d-keramikdruck-wachsender-markt-10102018/> [10.10.2018]
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## Expert question: What are the typical challenges of your new customers and what support and advice do you give them when they start out in additive manufacturing?

**Rousselet:** We have different types of new customers: the complete beginner in 3D printing or ceramics, the ceramist without 3D printing experience, or the last one who has 3D printing experience but not with ceramics. As a process provider, we accompany and adapt our support for each customer. Mastering the process of 3D printing with technical ceramics goes from generating a 3D printable file to firing the parts. To easily generate the CAD file, a key step, and to automatize our smart supports for printing, we have developed a new offer called Build-It. Another key step is to transfer the knowledge to make full use of the building platform to reduce the waste of material and time.

We accompany our customers in choosing the right 3D printer to serve their needs. For instance, when a customer wants to develop a part or to qualify a technical ceramic then the C100 is the smart choice. Easy to handle it's our smallest printer. It is easy to install and to master the process, so the customer can test and build up the necessary know-how to become an expert. Later, the customer may need to scale up for mass customization. Then the C3600 is the next good choice, thanks to its 600x600x300 mm building platform. Both printers work in tandem and have the same presets to scale up. We support customers with trainings to handle the whole process on both printers.

To 3D print, the ceramic is a key point. Hence we keep expanding our portfolio, providing more than 15 ceramic mixes: from Alumina to Silicon Nitride to Zirconia for printing on our range of printers. This

is a wide variety but in some cases our customers need a specific mix. So we also develop a mix 'on demand' for which tests and setting parameters in the printer are required. Finally, after the printing step comes the cleaning of the green part and the firing. As process provider we can also provide cleaning hoods and kilns.



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Nicolas Rousselet

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**Kollenberg:** The topic of 3D printing is on everyone's mind today. Nevertheless, it is difficult to get an overview of the possibilities and limitations of additive manufacturing. A first aid that we give to our new customers is a comprehensive overview of the processes available today. For this purpose, we use the internationally uniform terminology of DIN EN ISO / ASTM 52900, and provide an overview not only in theoretical form but also in our technical center.

Besides the numerous possibilities and advantages of additive processes, it is particularly important for the users to know their limits. Generally, it can be said that no single process is suitable for all conceivable components. Vat photopolymerisation can be used to produce components with high resolution, dense structure but limited volume. With binder jetting, the component size is almost unlimited, but the resolution is lower and the porosity is usually higher. Material extrusion offers the possibility to combine different materials, and by means of 3D screen printing only selected geometries can be produced, but in very large quantities in an automated process.

For the design, VDI guideline 3405 part 8.1 provides important information. Of course, for additive manufactured ceramic components the special characteristics of the sintering process must also be taken into account. In order to make use of the full design potential,

we advise our customers to initially put the geometry of the component in the background and primarily focus on defining the function and properties required by the application. This way, the freedom of design and thus the potential of additive manufacturing can be used effectively.



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Prof. Dr. Wolfgang Kollenberg

Prof. Dr. Wolfgang Kollenberg received his doctorate from RWTH Aachen University in 1984 and his habilitation at the TU Berlin in 1992. From 1979–1987 he worked at the RWTH Aachen University and from 1987–1990 at the Forschungszentrum Jülich. From 1990–1996 he held management positions at the German Institute for Refractories and Ceramics (Deutsches Institut für Feuerfest und Keramik GmbH). In 1996 he founded the WZR ceramic solutions GmbH, which he heads as managing director.