

GERMANY

ALUMINA SYSTEMS: Ceramic 3D-Printing on Industrial Scale

The highlight of the innovation day held by ALUMINA SYSTEMS in September 2019 was the inauguration of a new production facility to bring forward strategic growth in areas like 3D-printing and battery storage systems based on the NaNiCl-Technology. We have asked Managing Director Dr Holger Wampers (HW) about the progress of these projects.

CA: In 3D-printing of oxide ceramics ALUMINA SYSTEMS holds a leading position. What was the “learning curve” to achieve this competence?

HW: In 2015 we invested in a 3D-printer for lithography-based ceramic manufacturing and used the standard alumina and zirconia pastes available from Lithoz/AT for this printing system. We had to learn how to adapt debinding

and firing schemes as more than 20 % of temporary binders have to be removed. For every product, we had to determine the best printing scheme. We also had to study the market in which AM parts are competitive, and benchmark AM advantages with other shaping technologies (CIM, pressing, casting). The obvious advantages like freedom in part design or no need for mould/tool development and the costs involved were good arguments and the bigger platform seems to be promising for entering additional markets.

CA: In the new production facility, a bigger printer has been installed to manufacture more components. Has the next phase for industrial 3D-printing been reached now?

HW: Indeed, we are now operating a new printer with a building platform measuring 600 mm × 600 mm × 300 mm from the French company 3DCERAM Sinto/FR, which also uses stereolithography printing technology. It enables us to print big parts, but also covers the needs for printing large series (3000–5000 pieces dependent on size and geometry) of small parts. Now the competitiveness of 3D printing compared to other shaping technologies – pressing or CIM – is much better and we can support also our own production with the new AM technology. Certainly, AM is no more than just a prototyping technology.

For the production of large-size parts – we are talking about 1000 mm × 1000 mm –, we are working together with Lithoz/AT on a new printing system to widen the range of applications for AM. This technology allows in contrast to stereolithography very big parts with high wall thicknesses, printed in high speed.

CA: Could you give us some information on how this technology works?

HW: The big advantage is that we can work with water-based suspensions, which have max. 3 % additives. Therefore, we don't have to worry about a difficult, costly debinding process and can use our standard material mixes from production. With this printing technology we can deposit >200 µm per layer. A laser is used to dry the water between the ceramic particles. This system speeds up the printing



Fig. 1
Managing Director Dr Holger Wampers (l.)
and Dr Thomas Mühler (Team Leader AM)

(>10 times faster than lithography). Lithoz is our partner to design the printer, a first prototype should be ready for form-next 2020. We shall then fine tune the system to achieve optimal production performance. This will give us a real advantage in printing large parts. The prototype machine has a building platform 400 mm × 400 mm, but we aim to develop the system further to achieve 1000 mm × 1000 mm. Then we shall be able to replace parts made by means of isostatic pressing which need green machining to manufacture more complex shapes – and, of course, a tool.

With three different printers we shall be in the position to select the best system for the component to be manufactured. ALUMINA SYSTEMS is always on the leading edge of additive manufacturing and pushing the limits of this powerful technology even further.

CA: *Another new activity at ALUMINA SYSTEMS are stationary battery storage systems. What are the significant advantages of this CERENERGY product line?*

HW: These are “low-cost” ceramic batteries. The high-temperature sodium-nickelchloride (Na/NiCl₂) batteries (operated at 280 °C) are designed for economical stationary energy storage in connection with renewable energies for increased power generation.

Already in the 1980s, AEG has developed ZEBRA-batteries (Zero Emissions Batteries Research Activity) based on this material combination with the aim to push electromobility. Fraunhofer IKTS in Dresden/DE used these findings and developed the system further. These new batteries are designed for use in households and specific industrial applications (e.g. telecommunication, temporary storage for energy in wind parks).

We avoid crucial materials like cobalt and lithium, which is needed for lithium-ion batteries. CERENERGY batteries are 100 % recyclable and intrinsic secure as the ceramic core component is a sodium-beta-alumina solid electrolyte. They are inflammable and therefore safe in use. Thermal-environment-independent operation makes them also very interesting for hot countries. With a module efficiency of around >80 % and low cell degradation (service life >15 years with degradation lower than 10 %), they are very competitive. Li-ion cells will determine the market, but the NaNiCl-battery

will find her applications even if we think about H₂-combination for use in houses (heating and electricity) or H₂-filling stations. Here the inflammability becomes a main emphasis.

CA: *Do you have project partners to manufacture these batteries?*

HW: We have decided to produce the complete system in-house. All development work for the cells and system is based on a 3-year contract with Fraunhofer IKTS in Dresden. We shall manufacture the ceramic electrolytes, design the cells and complete them to modules with a special insulation solution. For home solutions we work with partners to establish a sales network, this means for us it remains a B2B business. For industrial applications we will have to tailor the systems. Therefore we aim to work directly with the users or with partners from the high current sector.

For use in households, we are also working in a project called H2 Süd supported by the Bavarian Ministry of Industry/DE. The idea is to store overproduction of energy generated from renewable sources to use it for hydrogen production. Another R&D project is smood – Smart Neighborhood (a Thuringian network sponsored by BMFT/DE), which aims at the refurbishment of residential areas to make them energy-efficient using renewable energy solutions in combination with other systems.

CA: *How have you managed to run the business in times of corona, what will change?*

HW: Of course, we had to adapt ourselves to this new situation. For a long period the communication with our production facility in Czech Republic was limited to digital meetings.

In our product portfolio we had to compensate the sharp decline of standard products (housings). Fortunately, we followed in the last years the strategy to develop a variety of products for special applications. This new business is fulfilling the budget plan.

Therefore we are in the good position to be able to act against the trend of a declining economy with investments and strengthened R&D activities. We have and will further invest in printers, but also extension of the building which includes also adaptations in the organisation.

CA: *Thank you for talking to us.*

KS

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