

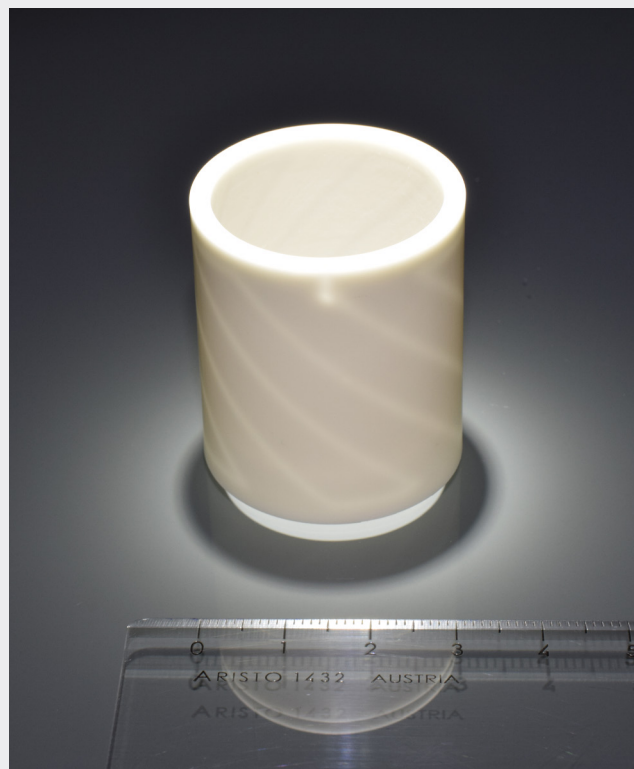
## INCREASE CUSTOMER VALUE WITH AM FOR HIGH-PERFORMANCE CERAMICS

The benefits of Additive Manufacturing (AM) in the technical ceramics industry are extremely broad. As can already be seen in more mature sectors such as metal and plastic, AM has the potential to revolutionize the entire manufacturing value chain, allowing for a shift: from mass production to mass customization; from centralized to distributed production; from cost to value-based pricing.

In order to make full use of the potential AM holds for technical ceramics, and to develop a strategy to create customer value, businesses need to focus on the benefits AM can bring to the entire value chain. Rather than focusing only on the cost of the produced part and trying to replace traditional subtractive methods, companies should focus on using AM to directly change the designing, engineering and manufacturing process, as well as how products are delivered and sold.

With AM, companies can accelerate prototyping, explore new designs for improving the function of a product, and ultimately develop innovative and customized applications at no extra cost. In addition, companies benefit from the lean manufacturing chain with fewer production steps and shortened assembly time for complex components that AM provides, and thus reduce the time required for conventional production. The digital storage of additively manufactured parts could also solve some outstanding issues in terms of stock management levels and delays in logistics.

These aspects unlock boundless opportunities for companies to create added value for existing and new customer segments, as well as to produce tailor-made products with a value-based price.



*Figure 1: freedom of design allows for that create customer value. The LCM technology allows for complex channels to be produced within parts which cannot be produced using subtractive manufacturing process.*

Find out how a company employs Lithoz systems to develop innovative applications and increase customer value.

**Alumina Systems Success Story on page 2.**

## SUCCESS STORY

Alumina Systems GmbH produces customized ceramic and metal-to-ceramic components for cutting-edge sectors, such as the semiconductor and medical industries. Alumina Systems GmbH employs LCM technology to develop products with high added value for its customers.

### THE PROJECT

To develop a new coating unit for Atomic Layer Deposition (ALD) equipment.

ALD is a vapor phase process used to produce thin films onto a substrate during the fabrication of semiconductor devices.

Due to the inhomogeneous gas distribution of conventional nozzles, the process of ALD is very slow, which is its major limitation. Furthermore, the lifetime of the equipment – conventionally of metal – is very short due to the corrosive precursors.

### THE SOLUTION

Alumina System GmbH, together with their project partner Plasway GmbH, developed an innovative ceramic distributor ring with integrated 3D-printed ceramic nozzles made of  $Al_2O_3$  99.9 %. The use of LCM technology allowed for the production of a nozzle with an innovative design impossible to be produced with subtractive manufacturing. The total ring was tested to vacuum tightness up to  $10^{-8}$  mbar·L/s.

#### Advantages of the innovative 3D printed ceramic nozzles

- The use of ceramic instead of metal greatly increases the lifetime of the equipment.
- Reduced machine downtime.
- Optimized gas distribution and uniform coating of a controlled thickness.
- **The time of the coating process was reduced by a factor of 3. One ALD machine can now guarantee the same production output as 3 machines.**

### CONCLUSION

With this project, Alumina Systems and Plasway technology have demonstrated how, by using LCM technology, an innovative new application can be developed which will open up new market potential due to the improved performance of the new parts, and therefore how LCM technology can radically improve customer value. The LCM technology enables innovative applications to be developed where the pricing can be based on the benefits of the product for the customer, instead of on the cost of developing and manufacturing the product.

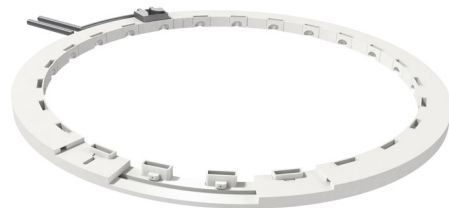


Figure 2: the distribution ring with twentyfour 3D-printed ceramic nozzles

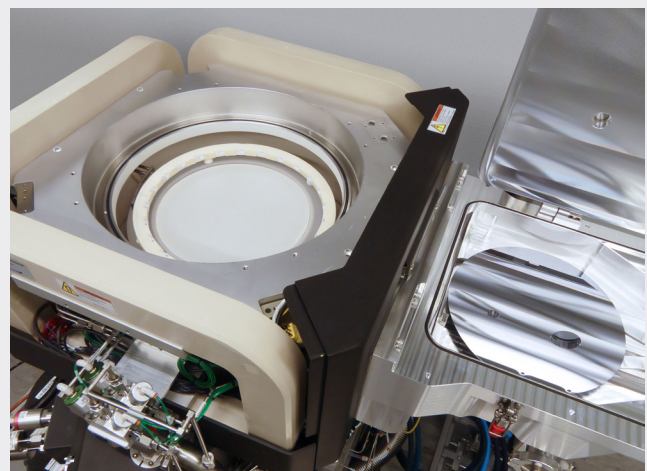


Figure 3: the new ceramic gas distribution ring with integrated 3D-printed nozzles, assembled in the ALD coating equipment.