ADMATEC
A NANODIMENSION DIVISION

eBOOK

ENHANCING PRECISION INVESTMENT CASTING VIA 3D PRINTING

NANODIMENSION
Electrifying Additive Manufacturing®

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INVESTMENT CASTING CHALLENGES

While investment casting is an industry-recognized and longstanding production technique that generates excellent surface finish and near net-shape capability, it can have a very long lead time, since it requires several complicated processes, especially for prototype or small-production runs. Part geometries are becoming more and more complex and higher accuracies are needed, meaning casters are approaching the edge of what is possible with the traditional casting process, using wax patterns. The increasing costs of skilled labor and refractory materials, make it necessary to look for processes which help the investment casting process compete with other processes. There are some environmental concerns as well including emission of gases, dust and particles, and waste generation.

3D PRINTING + INVESTMENT CASTING

Improving conventional investment-casting technologies by incorporating 3D printing helps achieve better, faster results while lowering cost and labor. 3D-printing is already used widely to produce casting patterns, but the process using patterns still has limitations to complexity, accuracy, and lead-time.

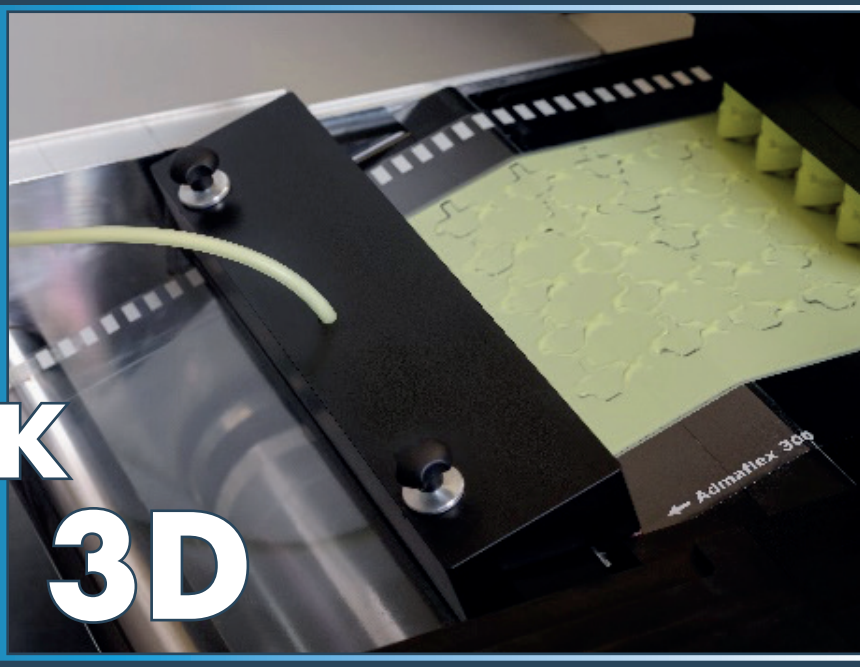
Additive manufacturing technologies are rapidly evolving and their applicability to investment casting grows with it. The most innovative projects can benefit from directly printing silica-based shells and cores, without the need for a wax pattern. A mixture of photopolymer resin and silica-based powder is printed directly into the mold shape, and they can be built on trees like normal.

With an intermediate step of polymer burn-out and sintering, the molds can directly be used to obtain small-to-medium size highly accurate metal parts. The use of light curing and the in-house developed low-shrinkage silica composition, allow high accuracy, very smooth surfaces and excellent knock off and leachability of the shell material after casting. The applicability also grows while increasing the accuracy.

FEEDSTOCK

To shape and to bond together the ceramic (or metal) powders in 3D investment casting, a high powder-filled mix is used. The feedstock 3D -printing technique allows the use of very fine particles in a safe way. These fine powders are necessary to obtain full dense parts with excellent surface finish.

Printing on additive manufacturing equipment enables you to produce complex geometries with tight dimensional tolerances, fine details and smooth surfaces. 3D printing technology, in combination with the superior material qualities of ceramics and metals, opens a span of applicability for high-tech industries with the potential to change the industry of the future.



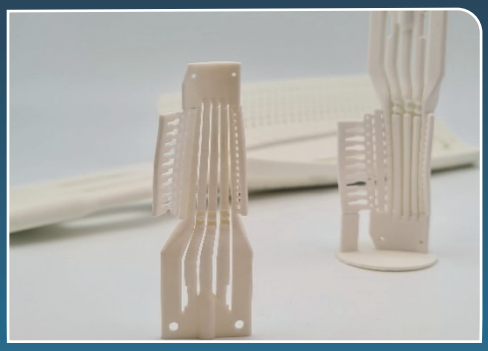
FEEDSTOCK BASED 3D

DIGITAL LIGHT PROCESSING

Digital Light Processing, or DLP, is a printing technique known for its ability to print fine features with a high resolution and low surface roughness. It is proving to be effective for 3D printing of shells and cores for investment casting.

DLP is a way of 3D printing layer-by-layer, using photosensitive liquid polymers cured through light. During the printing process, the layers are added and cured with help of UV-photo curing. After the printing, the parts are cleaned and undergo the debinding and sintering steps. By sintering, the material consolidates to obtain the properties of the ceramic.

3D IC



Ceramic 3D printing

In areas where integrated designs and functional material structures are required to improve performance, the benefits of additive manufacturing are significant. Though complex design or restriction to a specific material does not always apply, 3D printing can be beneficial by means of shorter lead times, cost reduction, waste minimization, and timesaving. 3D printing of ceramic cores eliminates the need for expensive molds and lengthy changeovers.

Ceramic 3D printing applications are diverse and growing. 3D-printing of critical aircraft-engine components such as turbine blades and fuel nozzles can help aerospace manufacturers develop more environmentally friendly and fuel-efficient aircraft engines – critical metrics for airlines and regulatory agencies.

Thanks to impressively complex designs, 3D printed ceramic casting cores open completely new possibilities in turbine design and successfully counteract the usual enormous cost pressures associated with aerospace applications. By printing ceramic shells and cores, a competing technology is available for 3D printing of metal, like direct metal laser sintering.

CASE STUDY

ARISTO-CAST

Challenge – Aristo-Cast, Inc., an award-winning investment casting source for both prototyping and production, was looking to reduce labor costs and cycle time. Because typical investment casting requires the use of a pattern to build a shell over it, and each pattern can be consumed only once, it is often a costly and time-consuming process. And when it comes to small, complex, and detailed internal channeling, it is extremely difficult or even impossible to produce using conventional investment casting shell building techniques.

Solution – Aristo-Cast uses two Admaflex 300 machines to print with fused silica, a ceramic material that breaks down in potassium hydroxide and water after casting is done, so the casting remains clean and unharmed while the ceramic entirely dissolves away.

Results – By using 3D printing investment casting shells (PICS) versus metal printing, Aristo-Cast can make very intricate internal configurations with an unsurpassed surface finish, while virtually eliminating the need for any post process. PICS has fully established standards for parts quality and allows for the ability to miniaturize investment-cast parts to sizes never seen before. PICS lowers the costs of capital equipment and parts produced and reduces labor and time.

"The Admaflex300 3D printer has taken the investment casting prototype manufacturing to the next level. Its simplicity and ease of operation are unmatched compared to traditional pattern 3D printing."

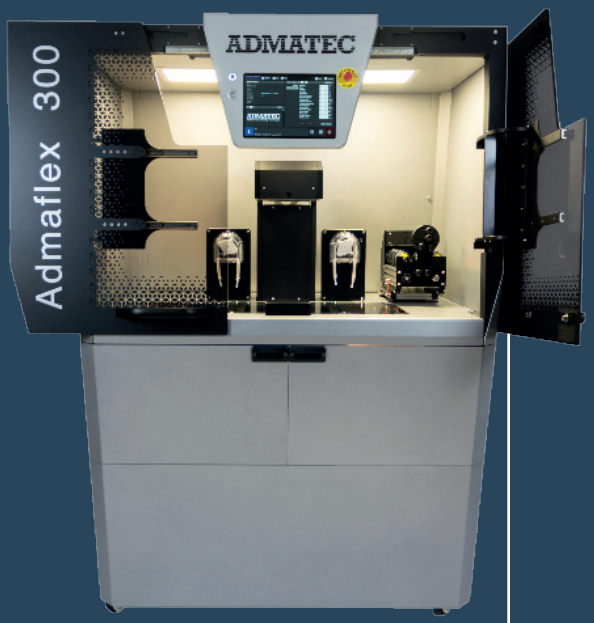
Jack Ziemba
CEO at Aristo-Cast, Inc.

YOUR 3D PRINTING PARTNER

The future is looking bright for additive manufacturing with approximately one-third of all businesses likely to use 3D printing over the next five years.

Admatec is dedicated to making ceramic and metal 3D printing accessible for production and development. Admatec supplies solutions for 3D printing, debinding and sintering, and provides training to help customers achieve the best results during each step of the process.

ADMATEC PRODUCTS



Admaflex 300 is a high-volume ceramic & metal 3D printer featuring a large build volume and the unique capability of 3D printing both advanced ceramics and metals. The Admaflex 300 is ideal for many demanding applications including mass-production of silica shells and cores for high precision casting.

The Admaflex 300 has an extremely stable machine concept for production, capable of handling feedstocks with a broad range of viscosities. The printer is available with build volumes up to 260x220x480 mm.

The Admaflex 300 has an integrated high-volume material handling system with automatic dosing to enable 3D printing of large components. It is designed to effectively handle materials with high viscosity, normally associated with ceramic slurries, enabling high reliability and speeds for continuous high-throughput and high-volume production.

ADMATEC PRODUCTS

Admaflex 130 is a ceramic & metal 3D printer featuring the unique capability of 3D printing both advanced ceramics and metals on one system. This technology is ideal for the development and production of functional and aesthetical parts requiring complex geometries, high resolution, fine details, and smooth surface while benefiting from excellent material properties.

The Admaflex 130 is designed to effectively handle materials with high viscosity, normally associated with ceramic slurries, enabling high reliability and printing speeds. This innovative system also enables efficient feedstock management by reusing the excess material.

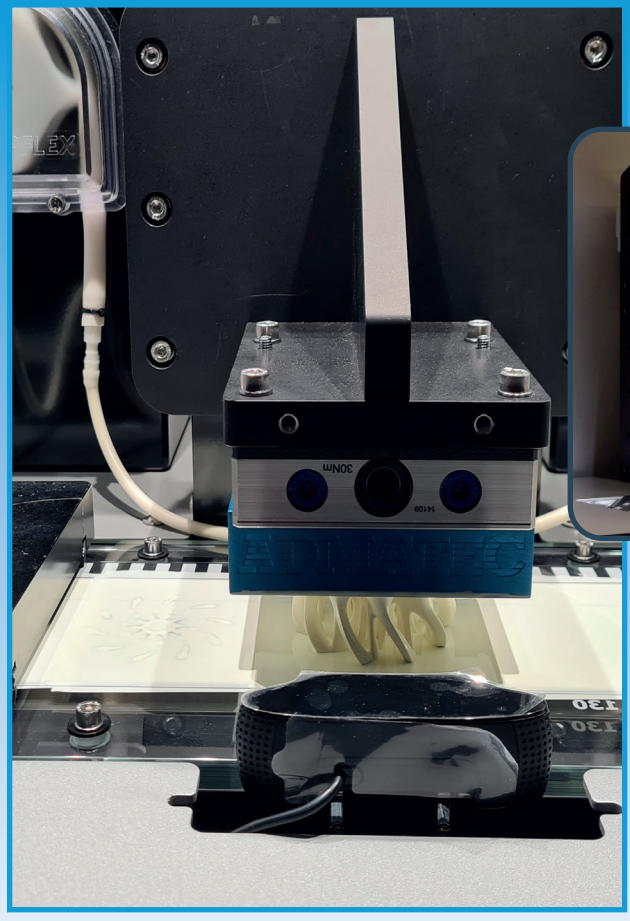
The Admaflex 130 is an open system that comes with comprehensive software which provides full control of the printing process. It also features a modular concept to accommodate all future developments.

ADMAFLEX TECHNOLOGY

Admaflex is the best commercially available technology for advanced ceramics 3D printing as it obtains products with fine features, high accuracy, and smooth surfaces. End-use parts of high dense ceramic and metal can be produced with excellent material properties, comparable with traditional shaping techniques. This technology enables the production of high-quality products for high-demanding markets, such as investment casting, aviation, medical, scientific research, and many others. The efficient use of printing material makes Admaflex technology ideal for cost-efficient production and development of materials. The high-speed process and scale-up possibilities make Admaflex technology an excellent choice for high-production volumes.

ADVANCED MATERIALS

Admatec also manufactures a variety of ceramics (Silica-based materials for shells and cores, Alumina, Zirconia, and other technical ceramics) and metals (Stainless Steel 316L/17-4PH, Inconel 625, Copper) for high-demanding applications. The AdmaPrint feedstock is specially formulated with a mixture of photosensitive resins and a solid load of powder (ceramic or metal), called feedstock system. The use of light curing and slurries allows achieving high resolutions and very fine surface roughness in printed products. Also, it prevents health hazards and cross-contamination related to the use of dry powders.
The AdmaPrint feedstocks can be used to print complex geometries, large and fine structures resulting in a wide variety of functional products.



ADMATEC/FORMATEC WANTS TO BE YOUR 3D IC PARTNER!

Admatec/Formatec, based in the Netherlands, are complementary businesses. Admatec designs and produces industrial-grade AM systems powered by digital light processing (DLP) technology that customers use to produce an array of parts for medical, jewelry, industrial, and investment casting uses. Formatec provides a proven service platform for design-to-production of industrial-scale parts that leverage the combination of AM and traditional manufacturing, such as injection molding.

Admatec/Formatec is constantly seeking to further develop technologies to advance the industry. They invest in research with a focus on the future and expanding the versatility of 3D printing. Their aim is to provide a flexible and open-architecture way of working, and they are continuously looking to improve their product portfolio by adding new breakthrough solutions.

CONTACT ADMATEC

PLEASE CONTACT US FOR MORE INFORMATION
OR TO SET UP A DEMONSTRATION!

NANO DIMENSION PORTFOLIO

Admatec/Formatec is now part of Nano Dimension, a Company that is Changing the Way the World Manufactures.

Nano Dimension's product portfolio now covers Additive Manufacturing, Additively Manufactured Electronics (AME), Printed Electronics (PE), Micro-Additive Manufacturing, AI deep learning, SMT Pick-and-Place, and inkjet solutions.

Nano Dimension Portfolio

NANO DIMENSION IS EXPANDING ITS PRODUCT PORTFOLIO TO ACHIEVE ITS VISION:

- **DragonFly:** Additively Manufactured Electronics
- **Fabrica Group**: Micro-AM solution for micron -resolution mechanical parts and manufacturing
- **Admatec**: High -volume ceramic and metal 3D printing for production and development
- **Essemtec** Adaptive, highly flexible SMT equipment, micro - dispensers, and intelligent production material logistics systems
- **Global Inkjet Systems:** Leading developer and supplier of softw are, drive electronics and ink system components

Driven by **DeepCube Group**: Deep Learning software embedded in printers and systems for realtime self learning and correction

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