

3D Printing Aluminium

Vidyasagar Veeramsetty

CMD, Sagar Asia Pvt. Ltd.

3D printing (additive manufacturing [AM]) covers a variety of processes in which material is joined or solidified under computer control to create a three-dimensional object, with the material being added together layer by layer. These processes have the potential to fulfil demands for reducing the design-to-manufacture time by replacing a series of production processes with a single-step process (followed by a finishing step, which is not considered a separate process step). This also shortens supply chains and lead times.

3D printing started and is still primarily done with plastics, due to their low melting point. Metals have higher melting points and, thereby, a higher amount of energy is needed. 3D printing for metals is either done with powder or by melting wire rods.

3D Printing of Aluminium

From automotive spare parts to satellite antennas, applications for 3D-printed aluminium parts are expanding due to the increased adoption of new aluminium materials developed specifically for additive manufacturing and 3D printers that are more finely tuned to optimize these new aluminium alloys.

Scalmalloy is a high-performance alloy made from scandium, aluminium, and magnesium developed specifically for additive manufacturing and is said to be stronger than titanium. On 8 October 2022, the Italian track and road cyclist Filippo Ganna put it to the test by riding a bike with a 3D-printed frame made from scalmalloy and achieved a record-breaking speed (56.8 km/h). The “world’s fastest bike” was 3D printed on a large format EOS M400 machine.

Aluminium AM creates objects out of aluminium powder or aluminium-filled thermoplastics. There are many benefits to producing aluminium using AM, such as reduced waste, increased geometry design freedom, efficiency, flexibility etc. AM aluminium parts are getting used in aerospace and automotive products where parts with complex geometries, lightweight and high strength are expected.

There seem to be only three companies in India doing 3D printing of aluminium, the most well-known among them being Intech Additive Solutions in Bengaluru, and the other two, based in Pune, being 3Deometry Innovations and Innovae 3D.

Methods of 3D Printing Aluminium

The most commonly used AM methods for aluminium alloys are laser powder-bed fusion (L-PBF) based, such as selective laser melting (SLM) and direct metal laser sintering (DMLS). The aluminium powder particles are exposed to the laser, to either selectively melt or sinter thin layers of the powder, and they fuse together and solidify. Once a layer is complete, another coating of aluminium powder is applied and the process is repeated until a three-dimensional object or series of objects are complete. From there, the parts must be removed from the loose powder and cleaned.

Electron beam melting (EBM) is another PBF process that can print aluminium parts using an electron beam instead of a laser. In binder jetting, a binding agent is selectively deposited onto thin layers of a dense metal powder, repeating it layer by layer, resulting in a green part, which is then subjected to debinding and sintering to remove the binder and fuse the metal particles together to create a dense final component.

Other AM methods are filament extrusion technology, where aluminium filaments are made from a combination of metal powders and a polymer matrix; and Wire Arc Additive Manufacturing (WAAM), which produces large-scale structures from aluminium alloys.

Advantages of 3D Printing Aluminium

- ✓ Good chemical resistance
- ✓ Very lightweight
- ✓ One of the best strength-to-weight ratios of any metal
- ✓ Combined with silicon and magnesium, it's the choice of many in the aerospace and automotive industry for its ability to withstand harsh conditions.
- ✓ Can craft highly-precise complex geometries and shapes that would be impossible with any other manufacturing method.
- ✓ Can print a multi-part assembly as one unit, drastically cutting down on manufacturing and assembly time, and developing a more efficient part overall.
- ✓ Cheaper than casting or machining aluminium, which often has higher production costs and uses more energy during fabrication, not to mention the additional cost of acquiring tooling or moulding.
- ✓ 3D printing also does not create much waste. By contrast, CNC machining is subtractive.
- ✓ Can produce low-volume and custom parts quickly and affordably and emerging technology continues to make both larger production runs and lower operational costs a reality.

#3DPrinting #AluminiumAdditiveManufacturing #Aluminium3DPrinting
#Aluminium