



ADDITIVE MANUFACTURING:

*RESHAPING MANUFACTURING OPERATIONS
FOR A SUSTAINABLE FUTURE*

Additive Manufacturing (AM) has emerged as a revolutionary technology in the manufacturing industry. It has garnered considerable attention and acceptance in recent years, fundamentally reshaping manufacturing processes, and introducing distinctive capabilities and value that were once beyond the reach of conventional manufacturing methods. It is important to note that while AM does not replace traditional manufacturing, it serves as a supplementary tool for manufacturers to consider in meeting their manufacturing requirements.

Push for Change

One major catalyst is the present emphasis on Environmental, Social, and Governance (ESG) initiatives. Both corporate social responsibility and government regulations are motivating manufacturers to expedite their endeavors toward sustainable manufacturing practices. While traditional manufacturing has served the purpose admirably for decades, AM has emerged as a more sustainable alternative, characterized by reduced material waste and carbon emissions.

Additive Manufacturing: A Sustainable Solution

As a promising sustainable technology solution that aligned with the objective of ESG initiatives, AM offers several key benefits, including:

Digital Warehouse and On-Demand Manufacturing: AM

enables production on-demand and minimizes the necessity for large materials stock and inventory. This results in reduced waste and overhead costs associated with inventory.

Repair instead of replacing with new parts: AM facilitates repairs of

damaged or worn-out parts, effectively extending their lifespan, and eliminating the requirement for additional raw materials and energy to produce new components.

Multi-material capabilities: AM

offers the ability to precisely apply materials, empowering manufacturers to use different materials exclusively where they are needed within a part. By applying materials selectively, manufacturers can create components with enhanced performance, durability, and functionality. This extends the lifespan of components, reduces the frequency of replacements, and minimizes waste generation.

Alternative to environmental hazards: Certain industrial

processes, including Chrome plating, utilize hexavalent chromium compounds that are highly toxic and carcinogenic to both workers involved in the plating process and the surrounding environment if not properly managed. AM can directly incorporate materials with inherent corrosion resistance properties into manufactured parts. This shift to AM not only improves workplace safety but also reduces overall environmental impact.

“LMD process is a direct energy deposition process, where metal powder is injected into a nozzle using a gas stream.”



Breaking New Ground: Makino ventures into Additive Manufacturing

Makino, a global leader in machine tool technology with headquarter in Japan since 1937, recognized the inherent material wastage and environmental impact of traditional manufacturing practices, has begun exploring metal AM several years ago. Being an expert in the metal machining industry, Makino believes that metal AM is going to become one of the mainstream manufacturing technologies of the future. Seeing the increasing trend for automation through the provision of turnkey services to customers over the past few years, Makino has extended its capabilities into additive manufacturing. The presence of Makino D500 at the Fraunhofer Innovation Platform for Advanced Manufacturing at the University of Twente (FIP-AM@UT) for post-processing of AM parts signifies Makino's readiness in contributing to the advanced manufacturing ecosystem. Additionally, the release of the Laser Metal Deposition (LMD) Machine in Nov 2023, co-developed together with Fraunhofer ILT, further underscores Makino's commitment to encouraging product manufacturers to adopt AM technologies.

LMD process is a direct energy deposition process, where metal powder is injected into a nozzle using a gas stream. The powder is melted by the heat of the laser beam to form a melt pool on the metal surface. The melt pool cools and solidifies to form a thin layer, parts are built up layer by layer. Tapping

existing strength in building a vertical 5-axis machine center, Makino believes that combining the 5-axis capability with LMD can greatly enhance the precision and manoeuvrability of the deposition process. LMD technology offers unique features and advantages that also serve to reduce the carbon footprint in parts manufacturing.

Makino's Sustainable Approach with LMD Technology for Eco-Conscious Production

Parts repairs through coating and build-up. LMD's 5-axis manoeuvrability offers a targeted and controlled approach to restoring damaged components by selectively depositing material using a high-power laser. Broken parts geometry could be built up through this technology. For high-wear tools, a more wear resistance or anti-corrosion layer could be added to extend tool life as well. The metallurgical bonding formed between coating and substrate is stronger than conventional thermal spray. This reduces the frequency of replacements and the associated consumption of materials and resources.

Thin coating layers with minimal post-processing save time and resources. LMD coatings are typically thinner than those from thermal spray processes. Thin coatings are preferred to maintain dimensional tolerances or fit within tight spaces, especially for aerospace components and medical devices. Thin coating could be achieved through LMD requiring minimal post-processing, saving time and resources.

Empowering Scalable and Efficient AM through Automation

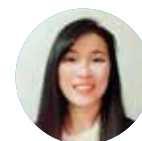
Implementing AM technology requires companies to adapt their operations and overcome the challenges that come with change.

Automation plays a critical role in scaling up AM production and addressing these challenges. For both the production and post-processing stages of AM, automation will improve and optimize the processes, maximize operational productivity, and further ensure a positive return on investment.

With years of experience in providing turnkey solutions for machining, Makino has rich experience in the field of automation and makes the AM machine to be automation ready.

Makino's diverse range of competencies makes it an ideal collaborative partner for companies across various industries. By leveraging its industry expertise, Makino and its partners identify and deliver tailor-made solutions that ideally meet the unique needs of each customer. ■

Author:



Joyce Lee Xin Yi
Principal Engineer
Additive Manufacturing,
Makino Asia Pte Ltd