

Abstract May 2018

Additive Manufacturing - a Revolutionary Enabling Innovation-Space Past Present and Future

Gideon N. Levy
Prof. D.Sc. M.Sc.
Additive Manufacturing and
Electro Physical & Chemical Processes
TTA Technology Turn Around Switzerland

Over 34 years ago, on 08.08.1984, Charles W. Hull filed the patent “**Apparatus for Production of Tree-Dimensional Objects by Stereolithography**” US 4,575,330. A new era in manufacturing started. This event followed by the inventions of the SLS 17.10.1986 Carl R. Deckard, FDM, 30.10.1989 Scott Crump and the 3DP binder printing by Emanuel Sachs MIT 20.04.1993. The slogan “**Complexity for Free**” (Terry Wholers) became reality.

Begin was polymers however; the immediate interest in metals printing came up. Starting with the mentioned SLS and Binder Printing for metal powders. Already in 1994 Ralf Larson invented the EBM ARAM patent US 5,786,562, nevertheless the first ARCAM EBM machine waited to the year 2012. The LENS® **laser-engineered net shaping** metal powder system (DMD) based on technology developed at Sandia National Labs started in 1997; the LENS® technology licensed to Optomec, Inc. 1998. “**Selective laser sintering at melting temperature**”, US 6215093 by Wilhelm Meiners, 02.12 1996 was the SLM milestone.

We can identify the following AM period's time-line:

1980 - 1995	Pioneers
1995 - 2000	Rapid Prototyping Rapid Tooling
2012	Terminology: Additive Manufacturing by ASTM
2000 – 2010	Early adapters
2011 - 2015	Euphoric Explosion DIY extrusion printers invasion

2016/17 can be recognized as a breakthrough game-changing milestone in the AM on the way to wide industrialization.

Joint research and industrial efforts with rewarding results. The polymer process move toward high productivity and away from the Laser as energy source. Metal fusion processes advanced TQM and Automation hence productivity and confidence. Moreover metal parts manufacturing reduce cost and moves partially away from laser as well. **Voxelization** is the new term, object building is controlled voxel by voxel in polymers metals and ceramics. Material for Process and not process for materials became possible. Design and modeling allow an optimized safe “Virtual Production”.

The AM broad arena, with multi-technologies, multi-materials, multi-applications is much more dedicated, economical and reliable, hence: AM the Enabling Space for Future Innovations.

The keynote paper will cover the latest state of the art in research and industry, point out trends challenges deficits as well as the great opportunities for the next years.

The AM is a permanently growing market with impressive forecasts, international large companies entered the business fields as OEM and users as well. The application fields are widely spread the aviation, energy sector, medical are leading recently the car industries are joining.

Joint research and industrial efforts with rewarding results.

The polymer process move toward high productivity and away from the Laser as energy source.

Metal fusion processes advanced TQM and Automation hence productivity and confidence.

Moreover metal parts manufacturing reduce cost and moves partially away from laser as well.

Voxelization is the new term, object building is controlled voxel by voxel in polymers metals and ceramics.

Material for Process and not process for materials became possible.

Design and modeling allow an optimized safe "Virtual Production".

The AM broad arena, with multi-technologies, multi-materials, multi-applications is much more dedicated, economical and reliable, hence: AM the doubtless the Enabling Space for Future Innovations.