Understanding Process Requirements for Additive Manufacturing on the example of a Beam-Based Process for Plastic Powders

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Generative or additive processing of polymers is well known since the late 1980's, early 1990's with a clear breakthrough in 1994 at which time machine sales took off exponentially. Since the beginning a great number of additive process variants were developed and a lot of qualified polymer materials for these variants were offered on the market. The latter was done especially in the field of photopolymers e. g. Stereolithography or Multi Jet Printing. Furthermore powder based processes like 3D-Printing or Laser Sintering were developed and especially Laser Sintering, a beam-based process shows a high potential for functional parts due to the durability of the thermoplastic nature of the used material.

This development was driven by the increase of applications starting with design and concept models, going via functional prototypes to manufacturing of spare parts or parts for end-user products as several applications shows.

One key point of the success story of additive manufacturing is the freedom of design for each individual part. Whereas the development of injection molding was driven by picking up the base-line of industrial thinking – making mass products, additive manufacturing now seems to have the potential to turn this paradigm to individualized or customized products.

After a first phase driven by the enthusiasm what can be done with additive technologies and a second phase of realizing the issues by trying to implement first applications now we are facing a period of naming the challenges more precisely and having started a lot of actions to overcome them.

This contribution gives a detailed view on some of the technological issues which restrict the usage of the most promising additive process for additive manufacturing, the Laser Sintering, a beam-based manufacturing process for plastic powders and try to indicate some solutions to overcome them.

The named issues are:

- In homogeneity of powder distribution in the whole process including powder pre- and post processes
- Insufficient constancy of energy input by laser and preheating elements
- Disturbances of the thermal balance during layer generating process
- Manual post processing
- Insufficient quality control approaches based on significant data

With my remarks I would like to motivate some of the best heads to think about these issues to get assistance for developing additive processes from rapid prototyping to additive manufacturing.