



Patrick Delfs

## **Quantitative Assessment of Surface Quality obtained by Post Processing of Laser Sintered Parts**

To quantitatively assess the surface quality (i.e. surface “roughness” on a number of scales) of laser sintered parts a reliable characterization method has to be found. With this method the surface quality of laser sintered parts depending on different machine parameters has to be analyzed in order to describe the correlation between machine settings and surface quality. Further testing will cover post processing methods to improve the surface finish with reasonable effort in terms of costs and labor. Furthermore, the effects of surface quality (due to sintering parameters as well as post processing methods) on mechanical properties as well as aging by comparison of post processed and untreated parts in long-time testing will be examined. The overall aim is a surface quality analysis of laser sintered parts.

### **Surface Quality Characterization Method**

#### ***Investigation of a surface quality characterization method applied for Laser Sintered parts***

This part of the project includes the investigation of diverse existing methods to characterize the surface quality and their applicability to assess laser sintered parts. For characterization of laser sintered parts it is important to keep in mind imperfections at different levels of scale: shape deviations (i.e. mismatch of characteristic admeasurements with design), surface deviations (e.g. waviness, terrace formation) and surface roughness (ranging from sub-millimeter to micrometer scale). Different methods are investigated in order to test their ability to assess surface imperfections at these different scales. Tactile and non-tactile measurement systems are investigated as well. As optical instruments white light interferometry and confocal laser scanning microscopy are investigated and evaluated. Main emphasis is on suitable mathematical methods to extract valid information about surface defects on different scales from obtained data.

Another challenge is to get comparable information from completely different measurement techniques. Further on a subjective assessment of the surface quality by haptic testing is aimed at. For this purpose suitable test specimens are used and assessed through blind-testing by different test persons. Finally, we aim to get a correlation of subjective and objective assessment of different surfaces. The resulting surface quality for different machine parameters (e.g. layer thickness, laser and scanning parameters) and powder quality (virgin powder vs. used powder) is tested with the methods developed previously. Especially the orientation of a surface in respect to the layer orientation has a huge influence on the surface quality, too.

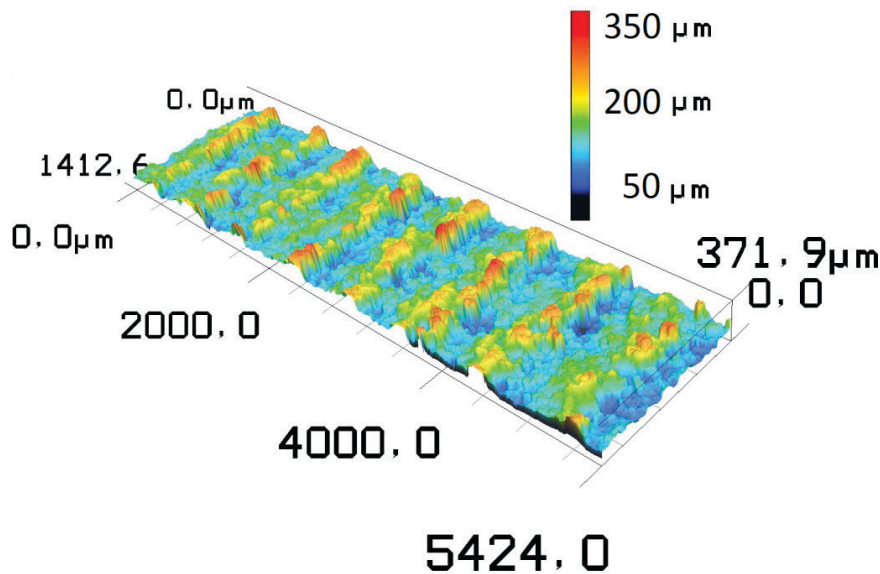


Figure 1: Surface topography of a tilted surface. The single layers and fused particles are obvious.

## Surface Finish according to Process Parameter

The post process is an important factor using the laser sintering process. After the unpacking process the powder has to be removed from the parts, which is performed by using a blasting cabin. In this part of the project the post process regarding the different post process parameter shall be investigated. The blasting time, the blasting distances as well as the blasting pressure are the most important parameters. Further on the blasting material shall be investigated as well. Next to the abrasive blasting method other promising methods like grinding and chemical etching will be used. The challenges here are also to find the right materials and parameters. Another step of this project should be the investigation of diverse coating processes. Because of a lower surface quality, compared to injection molding, laser sintered parts are not used in visible areas of the manufacturing fields. A coating might be the solution for this challenge. The main focus is on a harder and smoother surface with a minimal effort of manual labor. Therefore, reasonable target quantities have to be determined, such as lacquering properties and lacquering costs. Those should be specified as a function of defined properties, as a sensible parameter of surface roughness or a judgment of surface quality. The evaluation of these methods is done using the characterization method determined in the chapter „Surface Quality Characterization Method“.

***Investigation of diverse surface finish and coating methods according to chosen process parameters***

## Longtime-Testing of Laser Sintered Parts

The last part of the project deals with the ageing of post processed and untreated parts. Therefore the test specimens will be exposed to light, humidity and temperature for different durations until the longest of one year. On one side the ageing will be simulated with a defined exposure of above mentioned impacts and then compared to ageing by real weather of Paderborn. Measurements will be done to evaluate the influences on surface quality and as well mechanical properties.

***Investigation of influences by ageing on surface quality and mechanical properties***