FILLED MATERIALS FOR LASER SINTERING 2.0

In recent years, selective laser sintering has evolved from a rapid prototyping technology to a process for the direct production of sophisticated plastic components. In this context, the functional and mechanical properties of additively manufactured components are becoming increasingly important. However, there currently is only a limited selection of LS materials available, meaning that not all customer-specific requirements can be met. Particularly in the automotive and aerospace industries, filled plastics represent standard materials, as they can exhibit better mechanical properties, higher heat resistance or improved wear properties, depending on the filler. Therefore, filled laser sintering materials are currently being investigated at the DMRC.

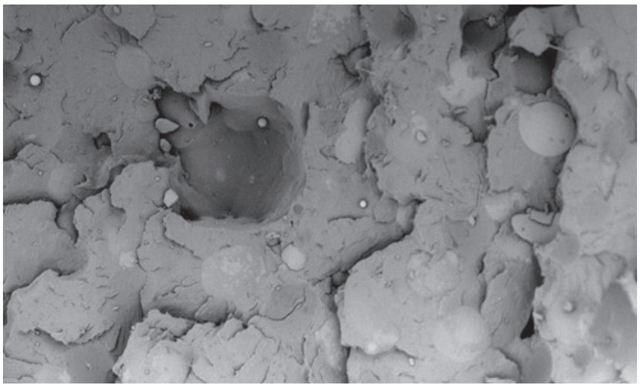

FIGURE 1: Crack Surface of laser sintered PA613 specimens blended with 20 vol% glass beads tested in dry state

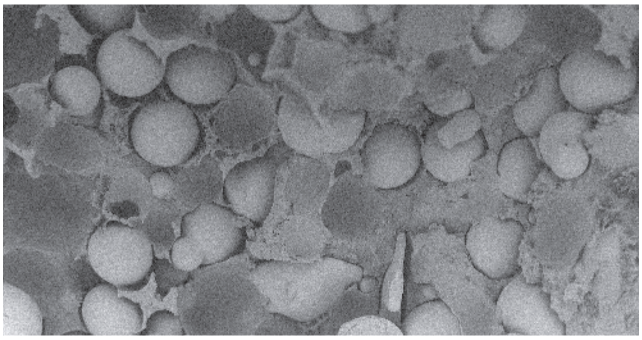

FIGURE 2: Crack Surface of laser sintered PA613 specimens blended with 20 vol% glass beads tested in conditioned state

PROJECT OVERVIEW

DURATION	03/2022 – 12/2022
PARTNER	DMRC
FUNDED BY	DMRC
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Motivation and Aim

The overall objective of the research activities is the development of a filled LS material that can be processed on standard LS equipment but is superior to the unfilled plastic powders currently available on the market in terms of component stiffness. This could enable new applications and markets for laser sintered components. In order to allow a systematic material development, the material behavior and in particular the interaction between polymer matrix and filler will be investigated in more detail on the basis of laser-sintered components. While the previous project, Filled Materials 1.0, analyzed the material behavior of dry blends, the current project will investigate the differences between filled powders in which the filler is embedded in the plastic particles.

Scope of the Project

In the course of the investigations of the Filled Materials 1.0 project, it was already found that the dry blending of spherical fillers can significantly increase the stiffness of laser-sintered components. However, the exposure to atmospheric humidity leads to a strong decrease in matrix filler adhesion. This was observed for all glass-based fillers in combination with PA613, even when a silane coating was used as adhesion promoter. The loss of adhesion between matrix and filler due to conditioning is clearly evident from the comparison of the fracture surfaces shown in Figures 1 and 2. PP-based blends also showed a deterioration of the adhesion between matrix and filler after conditioning. The degradation of the filler matrix adhesion leads to a significant deterioration of the mechanical properties.

The Filled Materials 2.0 project will therefore investigate whether the adhesion between filler and matrix can be improved by embedding the filler particles in the plastic particles outside the LS process. Potential improvements result if stable covalent bonds between polymer and filler can be established on silanized surfaces already before the LS process, and from improved coalescence, since the plastic does not have to flow around the filler.