Mechanical Characterization and Numerical Modeling of Laser-Sintered TPE Lattice Structures

Christina Kummert[1,3,*], Lena Risse[2,3,**], Matthias Häußler[3], Gunter Kullmer[2,3] and Hans-Joachim Schmid[1,3]

1 Particle Technology Group, Pohlweg 47-49, 33098 Paderborn.
2 Institute of Applied Mechanics, Paderborn University, Pohlweg 47-49, 33098 Paderborn.
3 Direct Manufacturing Research Center, Paderborn University, Mersinweg 3, 33100 Paderborn.
** christina.kummert@dmrc.de*
***risse@fam.upb.de*

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Abstract.
Additive Manufacturing provides the opportunity to produce tailored and complex structures economically. The use of lattice structures in combination with a thermoplastic elastomer (TPE) enables the generation of structures with graded properties. However, up to now there is little knowledge about the producibility of lattice structures made of TPE in the laser sintering process (SLS) and the resulting mechanical properties.
Consequently, the manufacturing of different kinds of lattice structures is investigated within this work. The cell type, cell size and strut thickness of these structures are varied and analyzed with respect to dimensioning, removability of the remaining powder and dimensional accuracy. As the Dodecahedron-cell shows the most balanced property profile, it is chosen for subsequent mechanical investigations. Within the experimental characterization especially static and cyclic compression tests of sandwich structures are focused and compared to standard test specimens. The material exhibits hyperelastic and plastic properties and also the Mullins-Effect. For the later design of real TPE structures, the use of numerical methods helps to reduce time and costs. The preceding experimental investigations are used to develop a concept for the numerical modeling of TPE lattice structures. In this way, extensive tests can be reduced later on.