PROCESSING OF THE ULTRA-LIGHT SYNTACTIC FOAM MATERIAL ECCOSTOCK® FFP USING SELECTIVE LASER SINTERING

Petra Juskova, Faculty of Engineering, University of Nottingham, Nottingham, NG7 2RD UK
petra.juskova@nottingham.ac.uk
Mark Swan, AWE Plc, Aldermaston, Reading, RG7 4PR
Anna Terry, AWE Plc, Aldermaston, Reading, RG7 4PR
Christopher J. Tuck, Faculty of Engineering, University of Nottingham, Nottingham, NG7 2RD UK
Ruth D. Goodridge, Faculty of Engineering, University of Nottingham, Nottingham, NG7 2RD UK

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Production of custom shaped, low density parts and components has a wide number of industrial applications, but also due to the nature of the material can be challenging [1]. Additive manufacturing forms final parts in a layer by layer process from a stack of 2D sections or slices and allows fabrication of almost any arbitrary 3D shape. Depending on the material and desired pore size, this technique can be used to prepare syntactic foams from open cellular structures as well as from composite materials with a high content of glass microspheres. Eccostock FFP is an off the shelf, epoxy-based composite free-flowing powder. Exposed to the temperatures about 100- 150 °C it cures into the rigid and ultra-light three phase syntactic foam (~ 0.1 g/cc). Material is standardly used for physical support and to provide thermal insulation for delicate electrical components in high vibration environments. In its powder form, it allows material to reach inside densely populated electronic packages and its low shrinkage means that electronic components will not be damaged during the curing procedure. The same characteristics also open the possibility to process this powder using the SLS system and benefit from the design freedom of the additive manufacturing technologies. Selective laser sintering (SLS) is one of the powder bed fusion processes, where parts are built using a laser beam as a heat source inducing fusion between powder particles. Powder is uniformly spread across the building platform and kept heated at a temperature just below the melting and curing point. Interaction with the laser selectively cures the polymer matrix entrapping glass microspheres, while the rest of the powder is unaffected and serves as a support. After each slice, the building platform lowers down a certain distance and a new powder layer is recoated on the surface [2].

In this work we optimised parameters for the processing of the Eccostock FFP powder in the standard SLS machine (EOS Formiga P100). Optimal process temperature and laser energy were defined. Using different sets of parameters we produced compression samples to evaluate mechanical properties of the final parts as well as the influence of the different printing parameters on the part density. We showed that syntactic foams parts can be produced using a relatively low processing temperature (below 70 °C) with short heating and cooling periods and exhibited good dimensional accuracy and shape freedom, making SLS an interesting technology to produce ultra-low density, custom shaped structures for industrial applications.

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[2] I. Gibson, D.W. Rosen, B. Stucker (2015), Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd ed., Springer, New York, NY

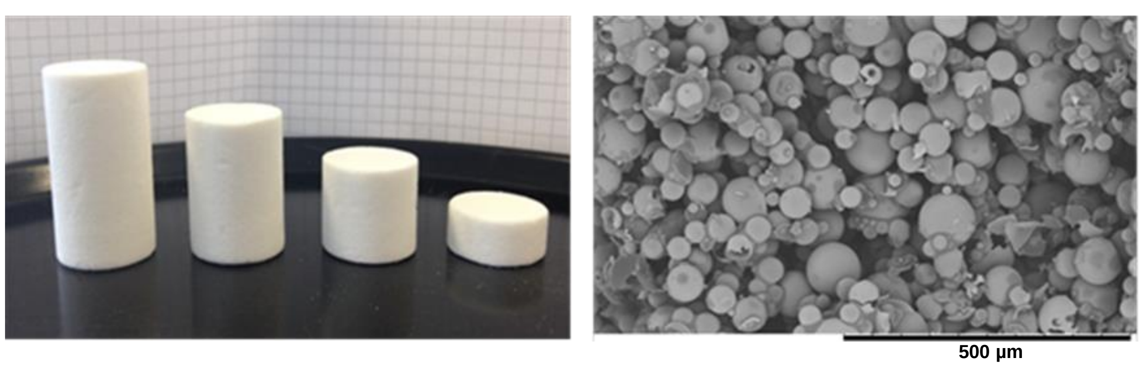

Figure 1 – Final parts prepared using optimized SLS protocol (cylinders with the 20 mm diameter and height: 40, 30, 20 and 10 mm) with the detail SEM image of the final part structure.