LIGHT
ADDING LESS SAVES MORE

Technology Strategy Board
Driving Innovation

**Bristol, 16 September 2014 – Technology Strategy Board project LIGHT; initial lattice test results**

The third quarterly meeting for the LIGHT project was hosted by HiETA Technologies, a Design and Product Development company that exploits the opportunities available through the use of Additive Manufacture (AM) for complex and high performance products. Together with the other partners Delcam, Bloodhound, Magna Parva, CRDM/3D-Systems, EOS and Simpleware the project progress has been discussed in Bristol.

The LIGHT project (full title Inspiring New Design Freedoms and Light-Weight Solutions for Metal Additive Manufacturing) is funded by the UK's innovation agency, the Technology Strategy Board. Potential improvements in the economy and performance of Metal Additive Manufacture (MAM) components will be investigated by the use of specialised software.

***The project has three main objectives:***

- To demonstrate additive manufacturing for three typical end-users by manufacturing light weight parts to demonstrate the benefits of AM utilising lattices and hollow structures.
- To develop an innovative CAD/CAM solution for lightweight product design for AM, including lattice structure design tools.
- To inspire new design freedoms for metal additive manufacturing to create advanced lightweight structures and products.

One of the key things to be able to inspire new design freedoms to the manufacturing community is to obtain mechanical properties of lattice structures for future product engineering. The main parameters for lattice design include different unit cells, unit cell sizes and volume fractions which result in different material properties for the final part. Before the consortium can apply the lattice structures to the three demonstrators, they first need to understand the relationship between the key design parameters for lattice structures, the (additive) manufacturing process and the mechanical properties of the final part with the lattice structure.

Over the past three months an initial set of test sample parts with lattice structures have been designed, manufactured and analysed to obtain the mechanical properties. The two main objectives were firstly comparing manufactured sample lattices with direct FEA simulation results and secondly obtaining material properties of the lattice, which in turn can be used for indirect FEA in the future. The Gyroid lattice was used as a unit cell. HiETA Technologies carried out the direct FEA analysis, assisted by Simpleware for the meshing of the 3D lattice geometry. FEA was done in parallel to the actual manufacturing of the samples, which was carried out by CRDM on EOS DMLS machines in Maraging Steel. EOS has taken these initial samples for compression testing (see Figure 1).

There was a significant difference between predicted and experimental deformation. The actual measured tensile strength is significantly lower on the manufactured samples, due to an assortment of reasons, including the rough surface and imperfections due to the additive process – the direct FEA assumes a too perfect lattice. The phrase "a chain is only as strong as its weakest link" also applies to the lattice, which in fact is a 3D chain and any imperfection in the manufactured lattice becomes the weakest link and results in lower measured tensile strengths. The material properties obtained from the tests can be used for the indirect FEA solution, allowing more efficient FEA based upon simulating lattices as a bulk material rather than the computationally intensive (and less accurate) simulation of the 3D lattice geometry directly.

Delcam eos e-Manufacturing Solutions magnaparva simpleware CRDM ENGINEERING SUCCESS HiETA technologies

With these initial results, the consortium has defined a second, more extensive, set of experiments to design, manufacture and crush lattice test samples to obtain more data, more statistically reliable data and also using different unit cell designs. The extended test plan was presented and discussed in the quarterly meeting. The experiments will be done in Maraging Steel in the next quarter so that the data is directly applicable to the first demonstrator, which is the airbrake door hinge from Bloodhound. The other two demonstrators follow sequentially, one using Inconel 718 for the HiETA Technologies thrust nozzle demonstrator and the Magna Parva's earth re-entry capsule demonstrator in Ti-6Al-4V. The end-users will use the obtained measurement data in parallel FEA studies to confirm the validity of the indirect FEA route.

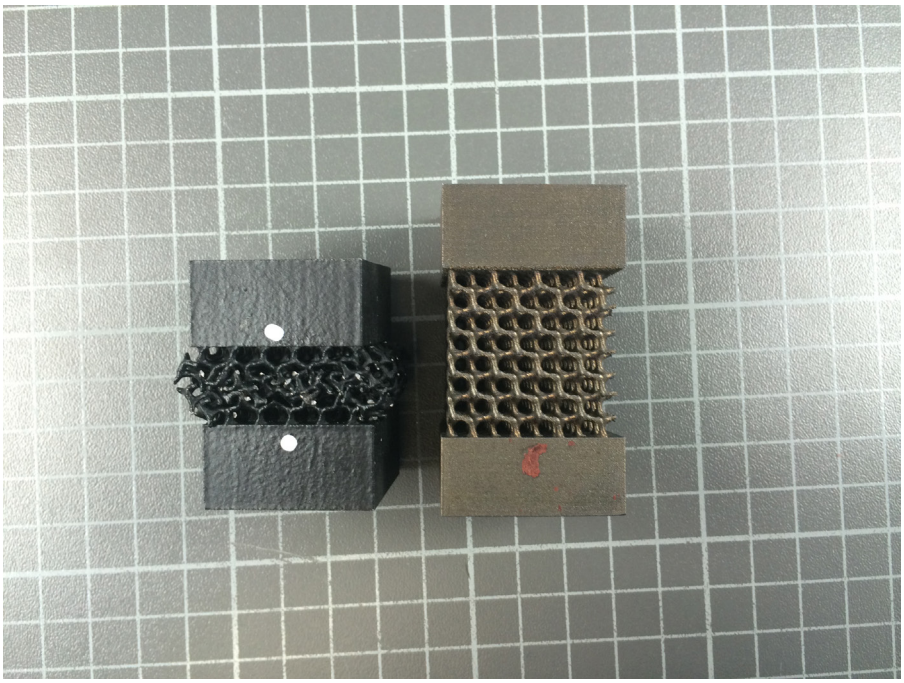

*Figure 1: Compression testing on test samples with Gyroid lattice structure*

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**Acknowledgements**
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