Design of an additive manufactured micropump assembly for space applications

Research theme	Additive manufacturing / product development
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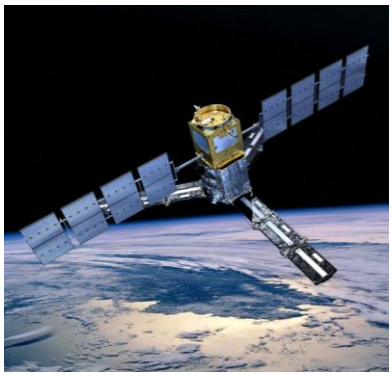
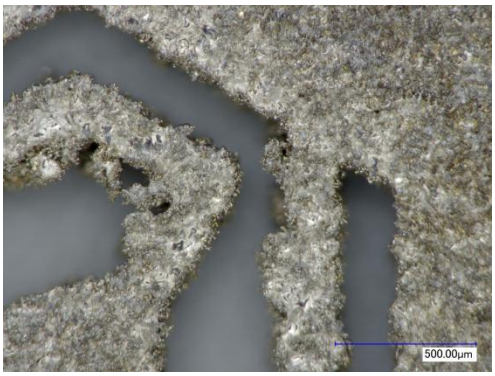
Background
Satellites contain electronic components that need to be cooled by pumped loops. Currently these loops are actuated by a single high capacity pump. If such a pump breaks down the complete satellite breaks down and therefore multiple spare pumps are sent along into space. The corresponding high mass and the Single point of Failure nature of these pumps make large pumps rarely used in space.

Assignment
This study focuses on developing an assembly of multiple parallel placed micropumps. The collective capacity of the micropump should meet that of the single large pump, but if a micropump breaks down the total pump capacity only decreases slightly. To survive space and high pressure applications the micropumps need to be produced in metal and need to be completely leak tight.

The research is an aim to deliver a proof of concept and therefore some prototypes are designed, produced and tested. For the research the prototypes are manufactured by the additive manufacturing method Selective Laser Melting (SLM). SLM is combined with the low temperature sealing method laser welding to achieve complete leak tightness of the product. Besides that some detail products are designed and produced, as shown in the figures below.

Results
The project resulted in a possible micropump design and in useful design rules for a future micropump assembly. SLM shows leak tight products, but the building accuracy of the method is critical for the small micropump design. Even though the SLM process is currently not applicable for all components, the results of this thesis established a great basis for future research and the micropump assembly still shows potential for future use in space.





Personal experience
I found it a very interesting and challenging master thesis in which both the theoretical and practical aspects were present. Thanks to both the NLR and the University of Twente I got limitless possibilities and freedom to draw my own lines and to let my initiative flourish. Besides that the working environment at the NLR in Marknesse is really nice and especially the intensive football matches during the brakes I will never forget. I liked the fact that the NLR challenges a student in a theoretical way, but also allows the student to include practical know-how and validation in the project.