Laser welding of AM metal parts as solution to provide new innovations for separation industry

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Additive manufacturing (AM) is an advanced method that can be used to produce parts with high level of complexity. This technique provides more design freedom as parts are manufactured layer by layer. Among different additive manufacturing process, laser powder bed fusion(L-PBF) has demonstrated ability to build highly complex parts with best resolution. However, one of the limitations of this process is the part size due to the building volume of equipment. Therefore, producing large AM parts is still challenging. One solution for this issue is to join small parts to produce final larger assemblies. There has been some works carried out in this field of research that have used different welding techniques to enable the solution. Nevertheless, none of the studies are based on joint optimized by means of AM for welding. Therefore, further studies and welding methods need to be explored to improve the welding quality of AM parts.

AM has been utilized widely also within Finnish industry during last years. One of most common question from industry is that can large parts be manufactured via AM. There is clear need to be able to produce large parts as Finnish manufacturing industry is typically making huge, bulky products. This differs a lot from example structure of industry of Germany, where in development of AM among aerospace industry has been the driving force. One solution for further utilization of AM to Finnish industry is to create larger assemblies by welding of AM parts together and with other components.

This study will concentrate on laser welding of AM parts. This can be also industrial solution for Finland, when only the part with best fit to AM of large component is printed and then welded together to larger assembly. This study has importance as knowledge in weldability of AM parts can provide totally new aspect for Finnish industry to be able to utilize AM to its full potential and volume. This study will be also important internationally as there is only a few studies of weldability of AM parts.

Additive manufacturing has not been utilized in the manufacturing of electrochemical systems, for example for separation processes such as the metal recovery purposes, earlier. By utilizing AM, the electrochemical systems with high efficiency and lower energy consumption compared to conventionally structured systems can be realized to work. This is gained via the ability to design AM systems by the requirements of electrochemical systems. Conventionally, design of systems is restricted by limitations of manufacturing method used, but as AM is layer-based manufacturing method, it enables manufacturing of totally new, complex designs. Because of freedom of design in AM, electrochemical systems can now be designed for example according to fluid dynamics. Furthermore, tailor-made systems produced by AM, are robust with tailored surface area, porosity, composition, and flow properties and can be coated to adjust the surface properties further for targeted applications. Additive manufacturing also provides possibility to use new materials for manufacturing of electrochemical systems. And laser welding provides excellent possibility to join these AM parts into larger structure, and thus introduces industrially feasible solution for this area of industry. This study will introduce these applications.

This study will introduce test results of laser welding of AM parts. This way developed optimization method and reliability of laser welding can be verified. This will also result industrially significant result, as it provides new solution for separation industry by utilizing AM parts as part of these processes, and provides way to combine AM parts to be part of larger structure.