



**ISHC 2013**

**DiGeSPo PROJECT**

**SELECTIVE LASER MELTING (SLM) OF  
COMPACT HEAT EXCHANGERS  
FOR HEAT ENGINES**

## WHAT IS SELECTIVE LASER MELTING (SLM)?

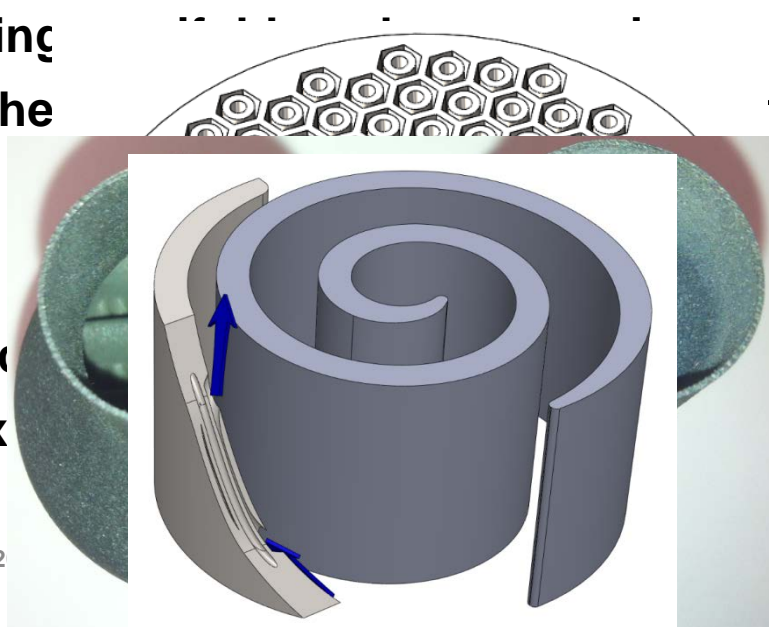
- **Additive layer powder manufacture using high performance alloys.**
- **With SLM we “grow” components from thin layers of fine powders.**
- **Each layer is a very thin horizontal slice of our component.**
- **A CAD-driven laser scans each layer.**
- **The laser melts each layer where it needs to be solid.**
- **The molten powder cools quickly to a fine-grained solid structure.**
- **Each new layer is melted into the previous layer.**
- **We use as many layers as needed to make the component.**
- **We release the finished component and remove excess powder**

## WHAT ARE THE ADVANTAGES OF SLM?

- **Very high degree of freedom of 3-D design.**
- **Ability to make extremely complex parts with internal voids.**
- **Ability to package components with new levels of flexibility**
- **Ability to combine more than one function in a single component**

## THE POTENTIAL ADVANTAGES OF SLM FOR COMPACT HEAT EXCHANGERS

- Very low hydraulic diameters and high surface/volume ratios.
- Tube-in-tube counter-flow heat exchange, 100% primary surfaces.
- Design out stress raisers for high pressures/temperatures.
- Optimised design of secondary/tertiary heat transfer surfaces.
- Control of surface finish.
- Heat-exchanging
- Integration of he



n components.

- Lower heat ex
- Higher heat ex

and weight  
systems efficiency.



## TECHNICAL AND COMMERCIAL BARRIERS

- **Product characteristics**
  - Wall thickness
  - Porosity/density
  - Surface finish
- **Materials**
  - Chemical composition
    - Initially Cu-Sn, Cu-Ni
    - Next stainless steel, Inconel
  - Powder size and size distribution
- **Process parameters**
  - Laser power & spot size
  - Scanning speed
  - Scanning patterns
- **Supply chain**
  - Capacity, integration



## EXAMPLE 1

- **Recuperator for Scroll engine or micro-turbine.**





## EXAMPLE 1

- **Laser confocal microscopy of Cu-Ni alloy + additives**

