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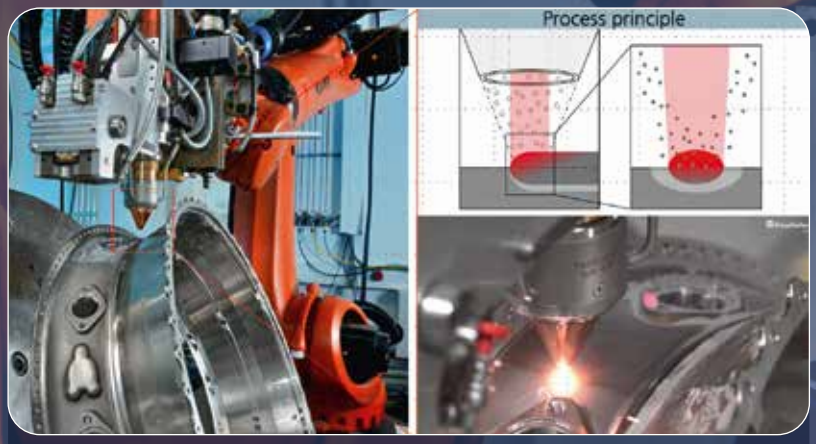
Funded by the European Union

Factsheet #5.1

Maturation of Additive Manufacturing Methods

Laser-based Directed Energy Deposition (L-DED)



In laser-based Directed Energy Deposition (L-DED) an additive material feed-stock, either metal powder or wire, is introduced to a melt pool, which is formed by laser radiation. By the relative movement between processing optics and the processing surface, a weld bead is deposited. This process principle allows the versatile application of L-DED in repair, coating and additive manufacturing of metallic components.

The flexibility of L-DED allows the process development towards application adapted specifications. As such, versatile metal alloys, relevant to space and aviation, can be processed. The process can be adapted towards a high productivity production with typical deposition rates of > 2 kg/h or towards the additive manufacturing of filigree structures with wall-thicknesses of < 1 mm. Furthermore, due to the process principle, the technology is scalable between the processing of small components till the manufacturing of large parts like a rocket nozzle.

Especially the additive manufacturing of all nozzle features avoids the current challenges of the production of such a component, which involves multiple processing stations like casting, welding and milling.

Companies involved

- ArianeGroup — FR, DE
- Fraunhofer ILT — DE
- IREPA LASER, Institut Carnot MICA — FR
- LCV Laser Cladding Venture — BE

Key parameters

- Scalable to bigger built sizes
- Feasibility of multi material processing
- Feasibility of deposition of filigree wall-thicknesses (~ 1 mm)
- Typical deposition rate of > 2 kg/h
- Resulting material properties at least equal to conventionally produced materials

Pros and Cons

- ⊕ **Scalable built size, not restricted to smaller components**
- ⊕ **High rate of material utilization**
- ⊕ **Energy efficient, laser-based process**
- ⊕ **Quality control with process sensors can be implemented**
- ⊕ **Can be automated**

- ⊖ **High degree of process complexity**
  Expert knowledge required
- ⊖ **Cost intensive metal powder with poor carbon footprint**
- ⊖ **Long deposition time for big components**

from **TRL 3**
lab scale application for subscale rocket engine elements feasible

to **TRL 5**
production of hardware representative of the application and adequate characterisation

Expectations for testing phase

- **0,6x** lead time for a rocket nozzle
- **0,5x** cost when compared to conventional manufacturing processes
- higher degree of freedom regarding the dimensional restrictions and choice of materials

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