Multi-metal additive manufacturing (AM)

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BACKGROUND

- AM helps on reducing the number of parts and weight
- What about reducing it further and increase the performance by having tailored properties across the parts?

Multifunctional Ti flaperon

HOW?

1. Literature study and material selection
   - Criteria definition
   - Material availability check
2. Process parameter optimisation
   - Selection of laser power, travel speed...
   - Lowest porosity, optimum interface
3. Material characterisation
   - Interface quality testing: static, dynamic, hardness
   - Multi-material interface selection
4. Demonstrator production
   - Feature definition
   - Print path optimisation
   - Demonstrator production

WHY?

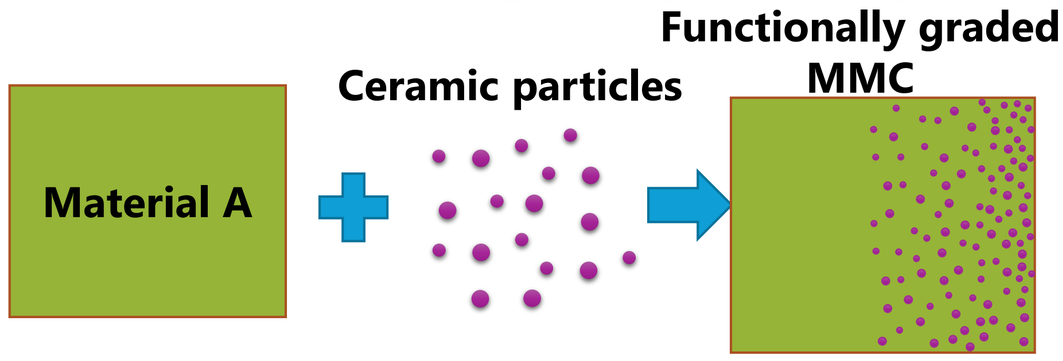
- Not all materials can be combined
- Cracking, delamination, pores...
- Great potential to lower number of parts and weight

OBJECTIVE(S)

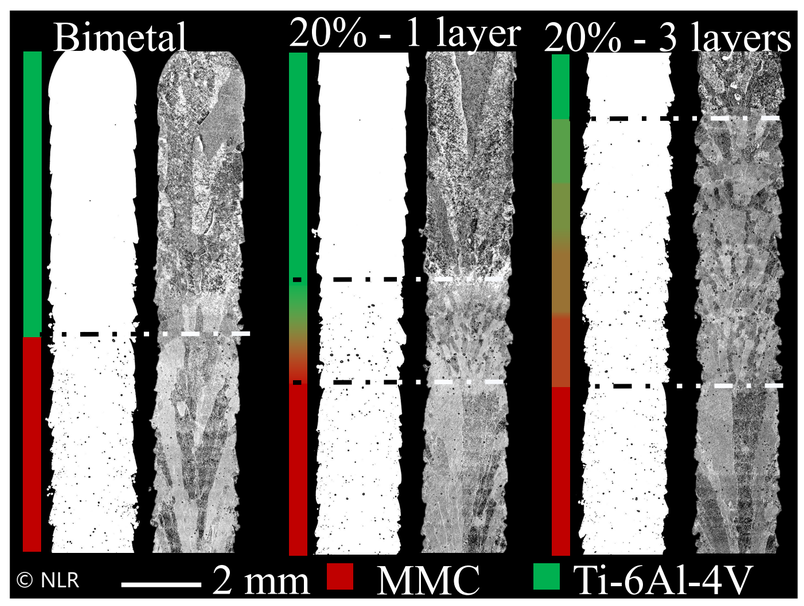
Combine dissimilar material (or properties) to obtain components with varying mechanical properties.

RESULTS

1. Material selection:
   - Aluminium and titanium challenging ✗
   - Potential on metal matrix composites (MMCs) ✓
     - Increase strength, toughness, fatigue



2. Process parameter optimisation
   - Route 1 : Ti-6Al-4V + TiC



[1]

➢ Crack free, ↑ strength, = elongation

   - Route 2: Aluminium +TiB_2 (Collaboration)

Lessons learnt: pre-alloyed powders are preferred for handling, machine and higher quality/homogeneity

Promising Research Knowledge Event | 21 November 2024

Acknowledgement
This research is conducted within the research and innovation programme Luchtvaart in Transitie, which is co-funded by the Netherlands National Growth Fund

[1] M. Montero-Sistiaga et al. "Directed energy deposition of functionally graded metal matrix composites: Ti-6Al-4V and TiC," presented at the Fraunhofer Direct Digital Manufacturing Conference, Berlin, 2025.