



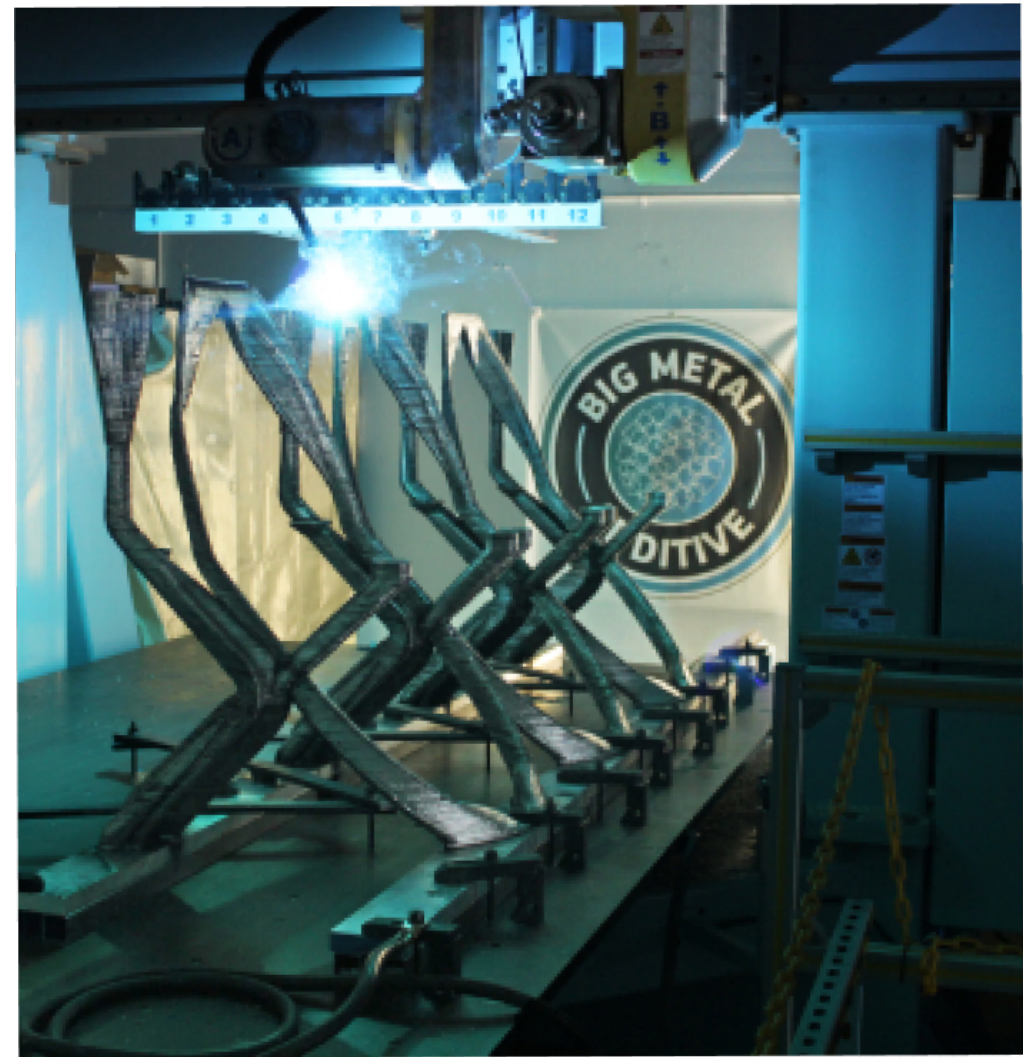
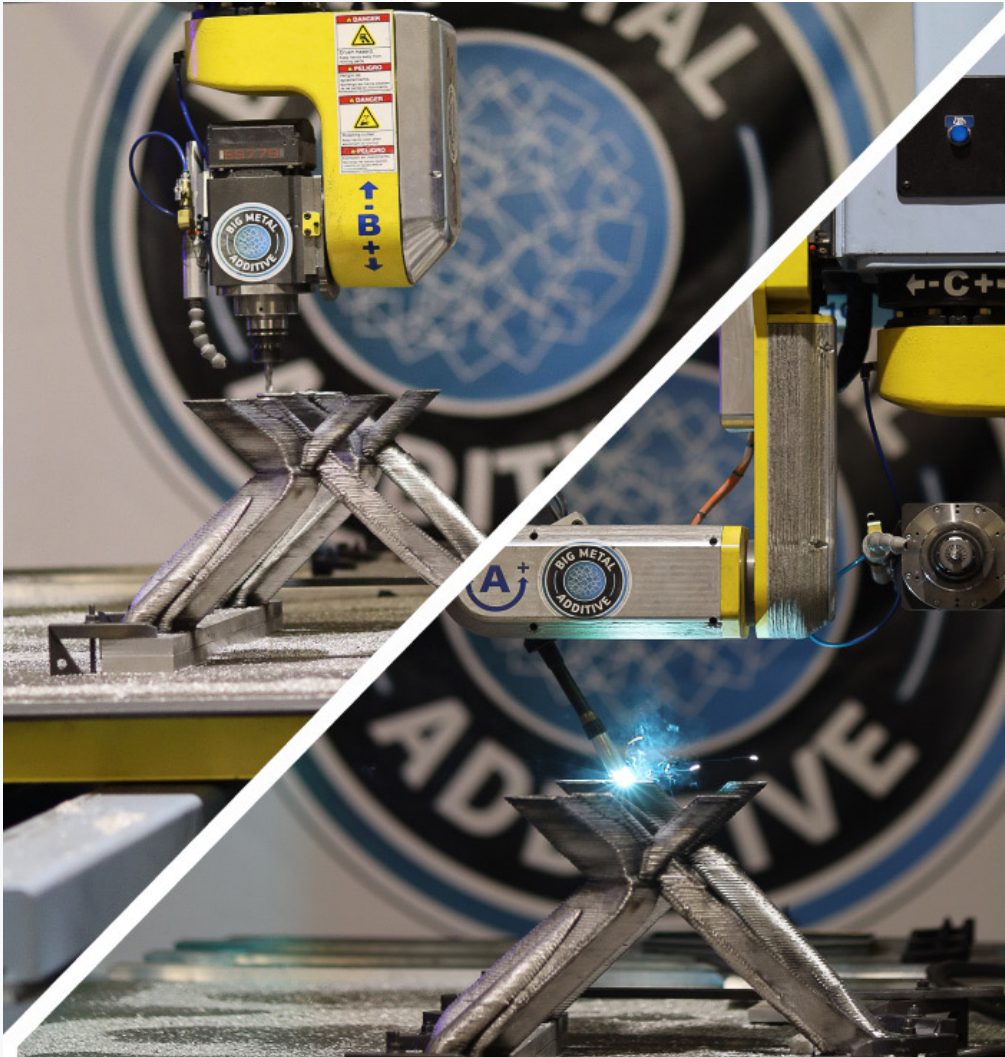
Hybrid Metals Manufacturing

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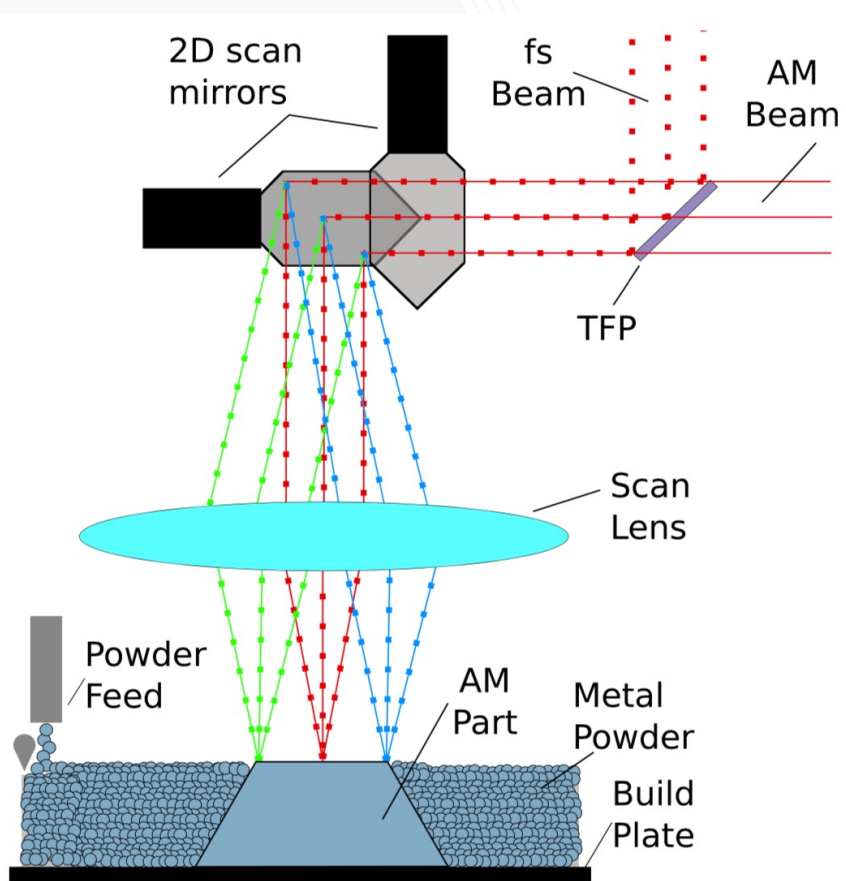
November 19, 2021

Cooperative additive and subtractive tools realizes greater precision and reduces build path iterations.

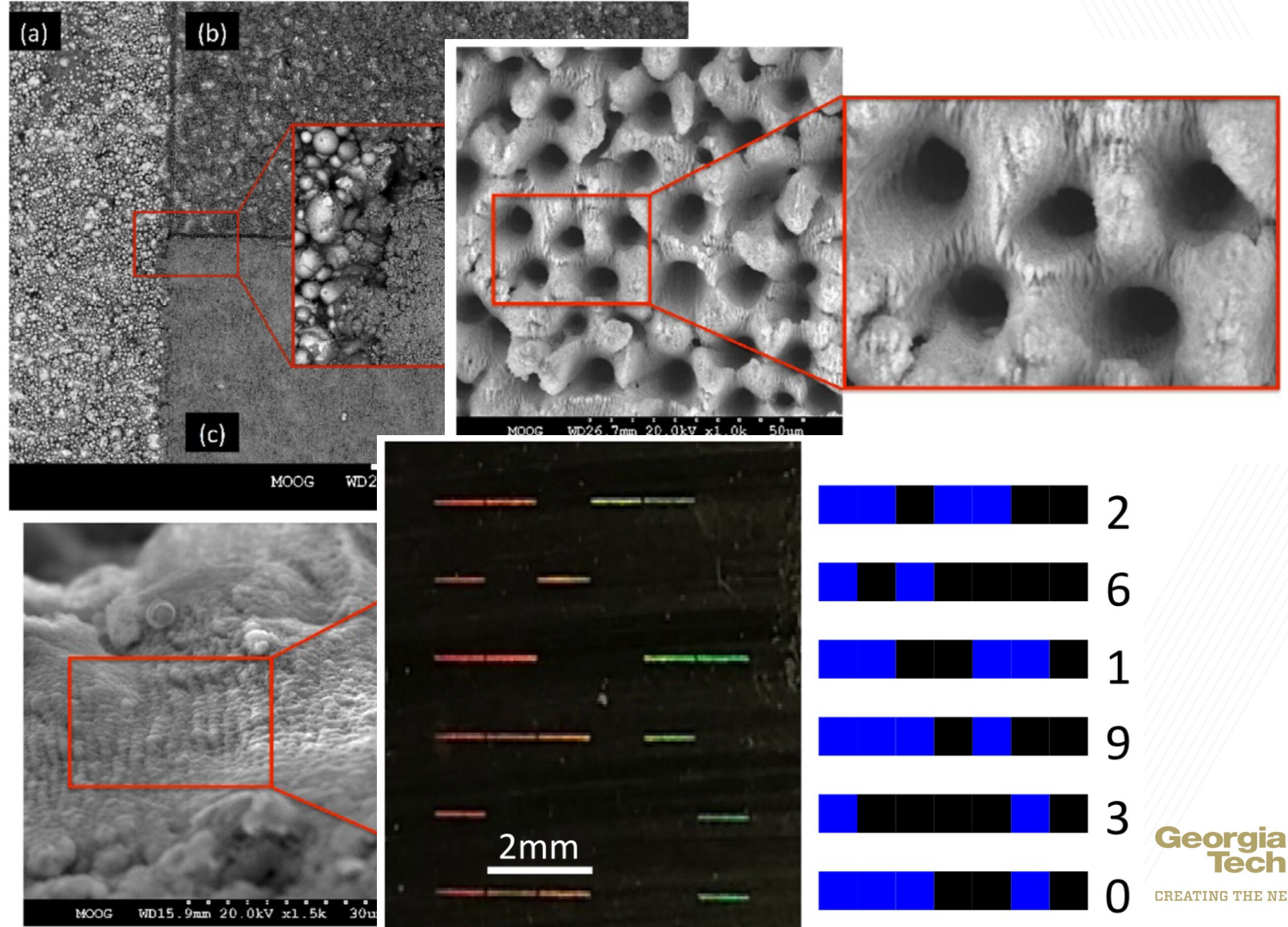


Figures from: <https://www.bigmetaladditive.com>

Dividing tasks amongst multiple tools can simultaneously increase cyber-physical security.

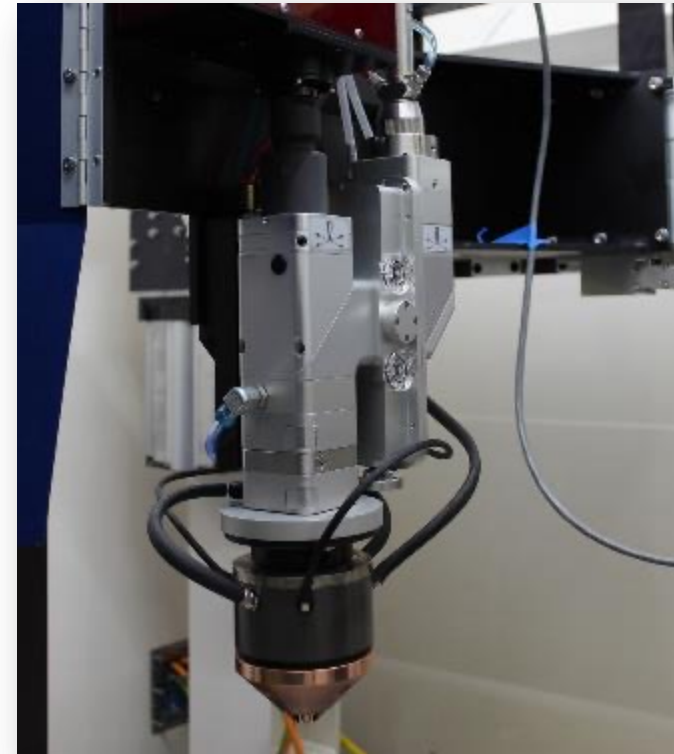
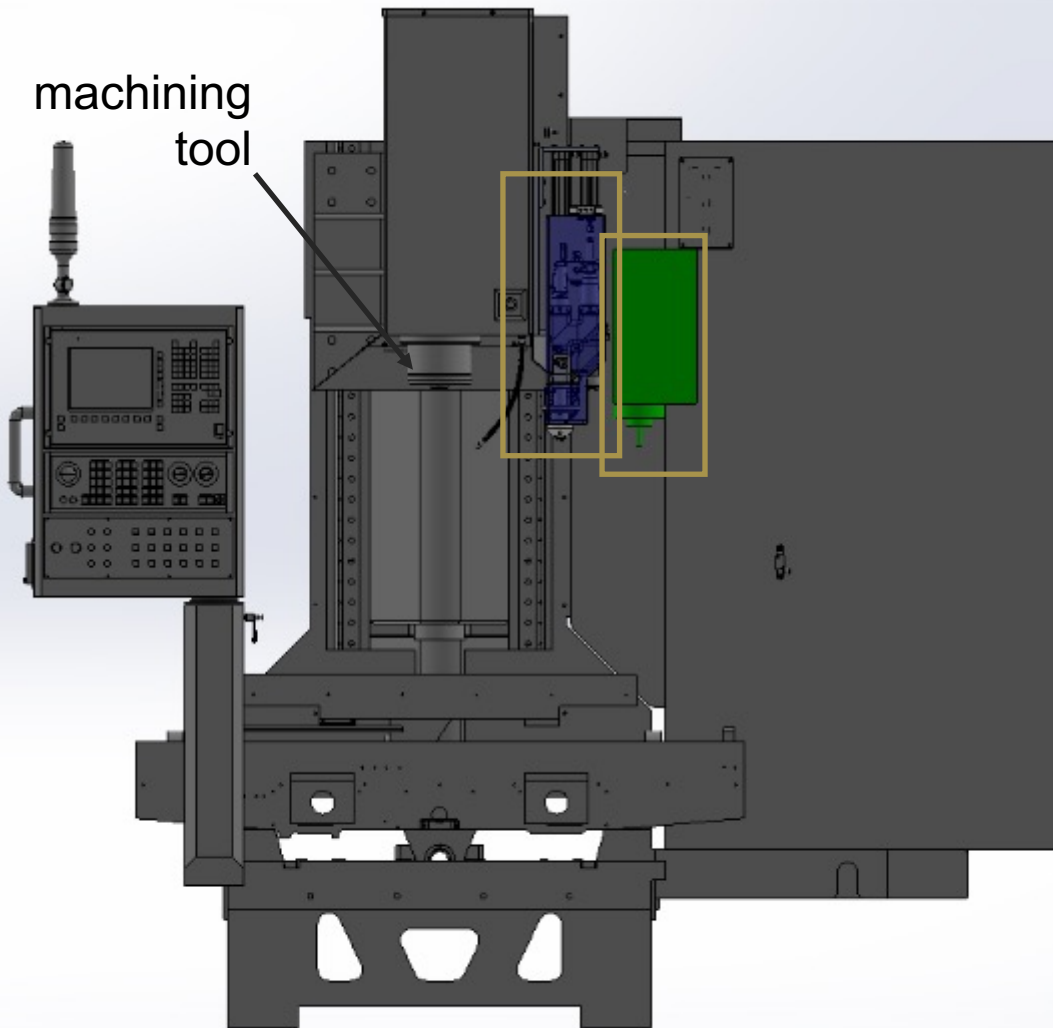


Worts et al. Optics Communications 430 (2019) 352-357.



Hybrid Near-Future: Beyond two tools/processes and one material.

Powder DED Tool



4-tip Nozzle

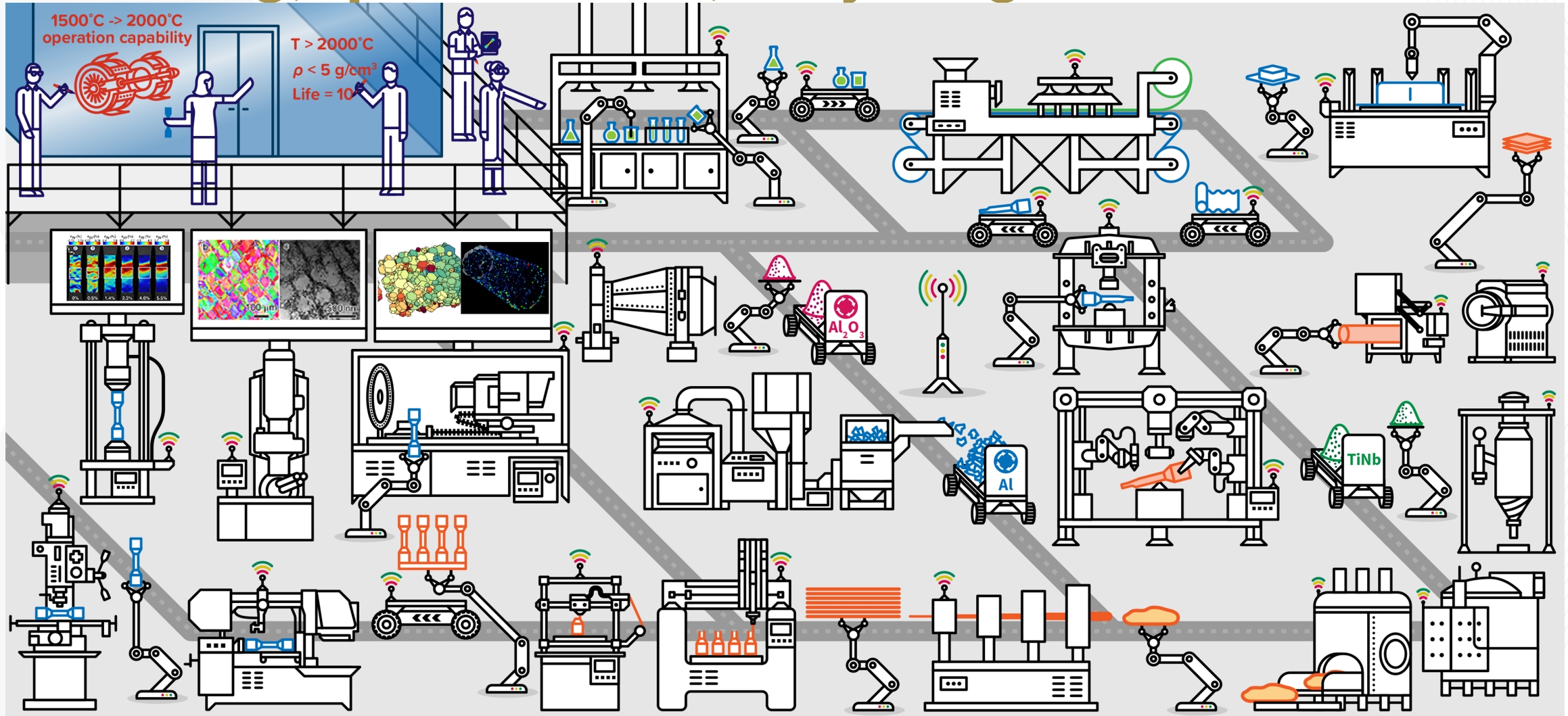


Coaxial
Nozzle

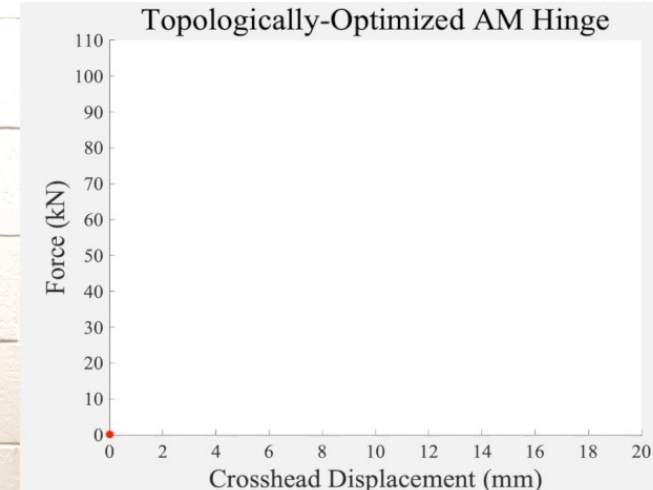
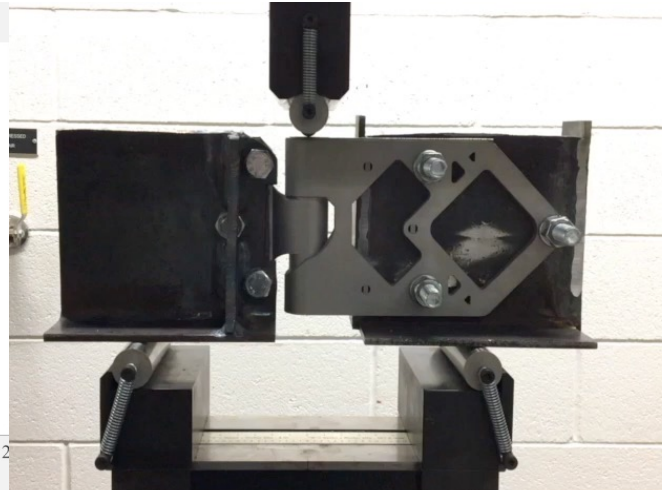
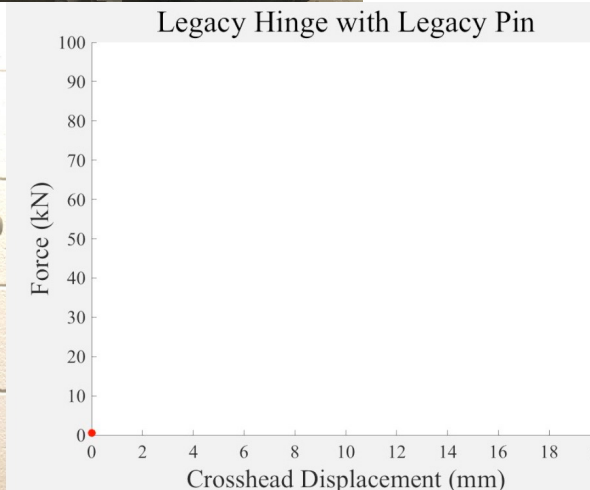
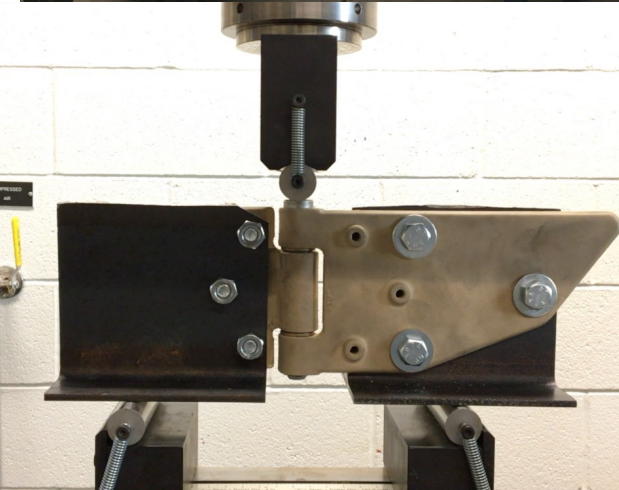
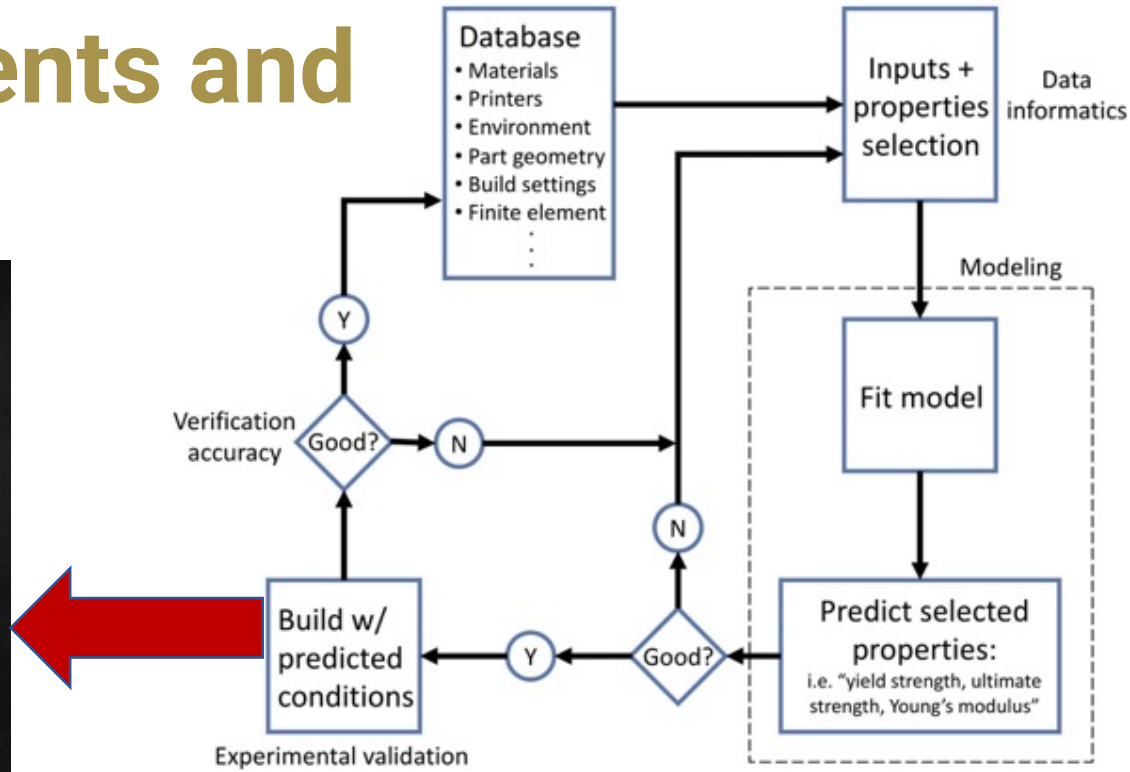
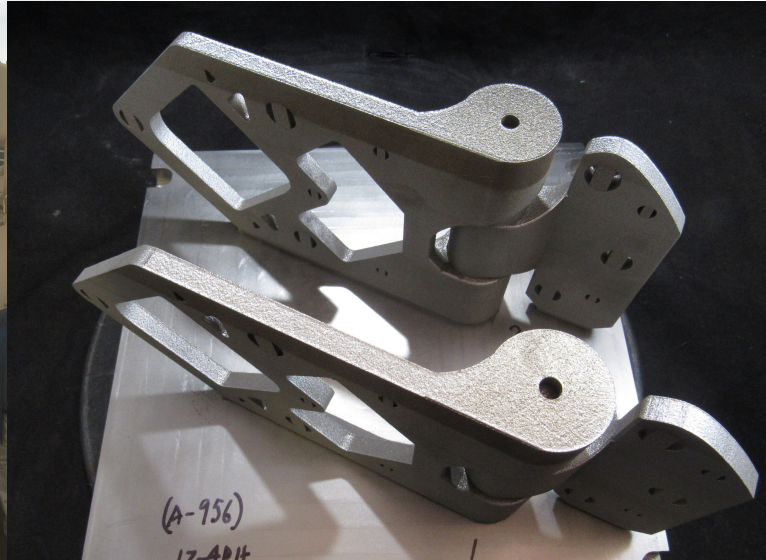
Fraunhofer
Center-feed
wire DED tool



Hybrid Future: Human-AI integrated synthesis, processing, qualification, recycling.



Enables continuous improvements and resource utilization.





Thank You