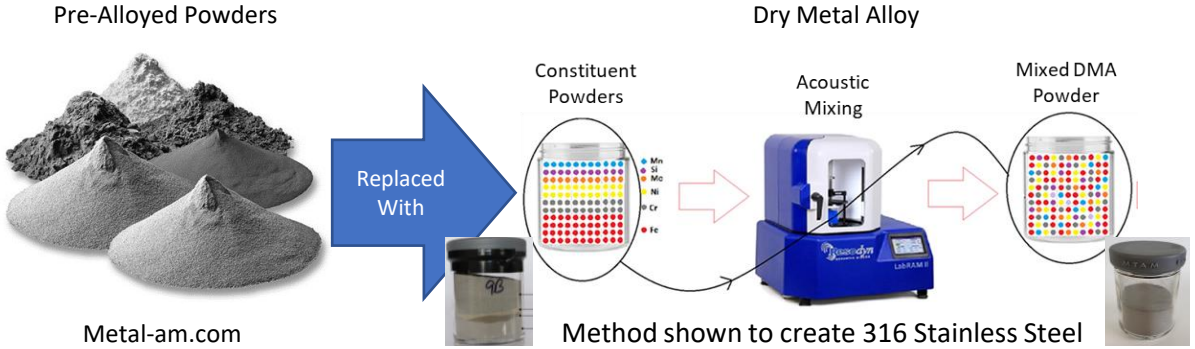
New Material Development & Reduced Stock Enabled by Novel Mixing

Motivation

Additive manufacturing (AM) can produce a wide variety of components at the point of need. However, numerous alloys are used in military equipment, which requires stocking numerous alloy feedstocks and presents logistic challenges.

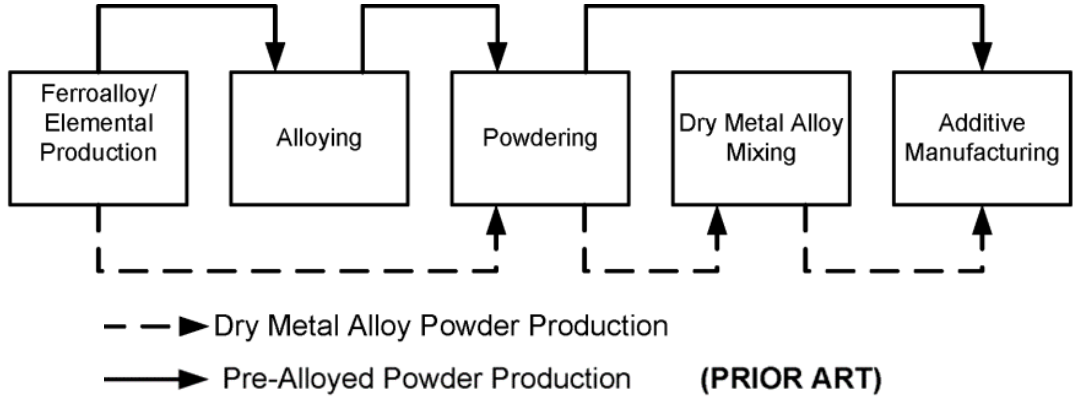


Metal-am.com

Method shown to create 316 Stainless Steel

Current Research: Dry Metal Alloying (DMA)

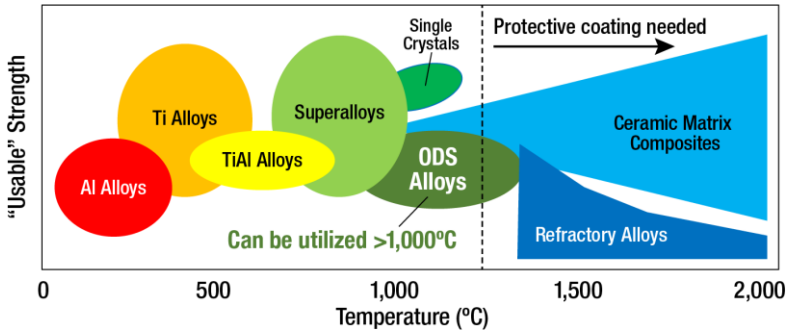
DMA allows many alloys to be created from a few constituent feedstock powder reducing the number of materials required to be stocked.

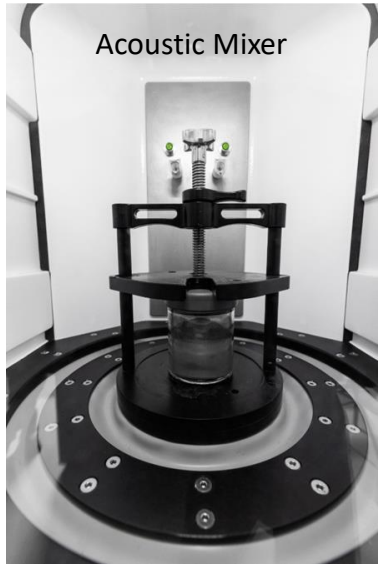


Patent Pending Process:
https://patentscope.wipo.int/search/en/detail.jsf?docId=US357568656&_cid=P21-L6LPC2-37936-1

Future Applications

Development of Oxide Dispersion Strengthened (ODS) Materials and Other Functional Materials.





Research Leads

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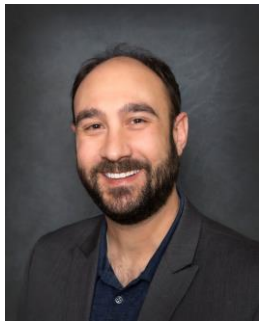

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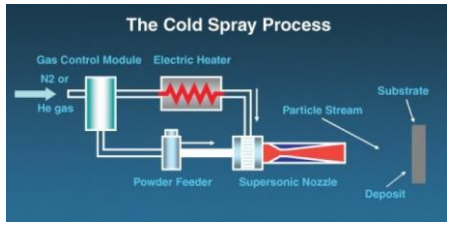
Advanced Methods in Cold Spray Technology

Objective

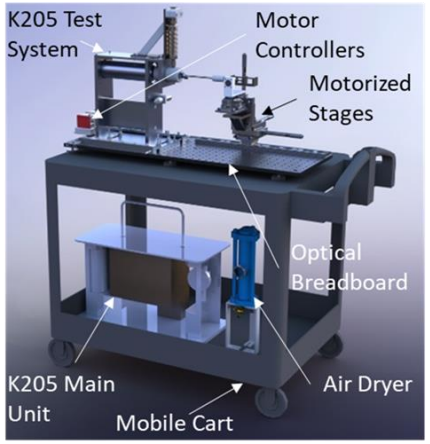
Cold spray techniques are routinely used to perform in situ repair and maintain components in the field. The current underdeveloped design significantly limits the material selection and effectiveness of cold sprayed materials. The research objective is to expand the applications for cold spray by developing an understanding of nozzles through simulations and empirical research.



https://www.army.mil/article/148465/army_researchers_develop_cold_spray_system_transition_to_industry

Experimental Research: Test Fixture

The in-house designed and built test fixture is instrumented with temperature, pressure, and velocity sensors to measure fluid properties in the plume of a Rusonic K205 cold spray system. The empirical measurements are used to validate the CFD models.



Modeling Research: Computational Fluid Dynamics (CFD)

Cold spray nozzles and plumes are being modelled with CFD software to develop a theoretical understanding of fluid mechanics in the cold spray process. The knowledge gained will drive future cold spray nozzle designs.

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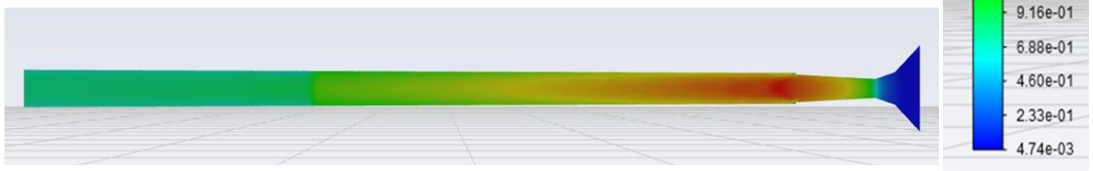

Future Applications:

Leverage knowledge gained from CFD and experiments to design specialized nozzles for novel cold spray applications.

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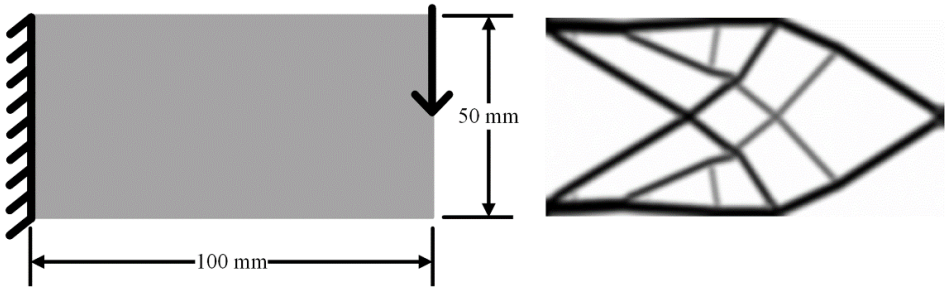
Topology Optimization for Reduction of Vehicle Weight to Save Energy

Motivation

Improving the efficiency of technology has become very important in the modern world. For anything with moving components, one of the best ways to improve efficiency is to reduce the mass of the parts. By reducing the mass of components, the following can be achieved: 1) reduced operating costs, 2) preserve resources, 3) extend the range of electric vehicles, and 4) improve the payload capabilities of commercial vehicles.

Topology optimization is a powerful tool that creates lightweight designs. In the figure below, a basic part is shown on the left, and an optimized version is on the right using only 20% of the original mass.

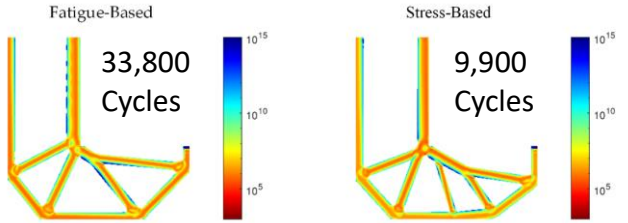


Future Applications

Development of topology optimized specific vehicle parts that will withstand cyclic loading.

Current Research: Topology Optimized for Fatigue

To make topology optimization more effective for dynamic components, fatigue constraints have been incorporated into the optimization process. By accounting for fatigue, the created parts will outperform designs created by traditional stress-based algorithms. As presented below, the fatigue-based design is predicted to last over three times longer than the traditional stress-based design with both having the same mass.



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