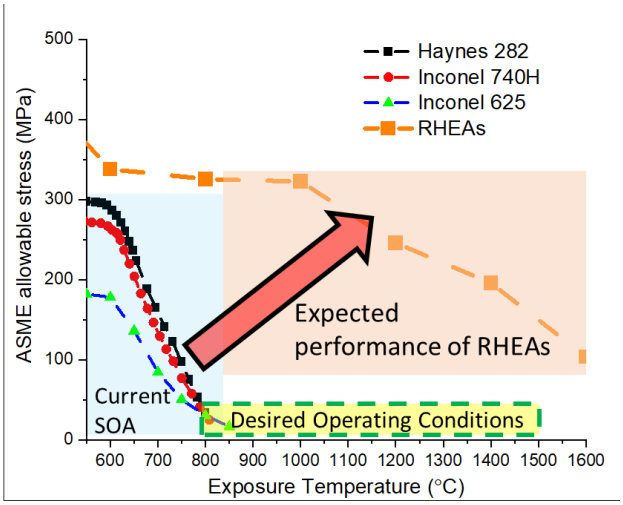
REFRACTORY HIGH-ENTROPY ALLOY (RHEA) COMPACT HEAT EXCHANGER

Patent Pending
SD 14916
Technology Readiness Level: 3
Concept demonstrated analytically or experimentally

Recent breakthroughs in hybrid advanced manufacturing and advanced alloys can significantly extend the temperature and pressure operational range of heat exchangers

When it comes to their material properties, high-efficiency compact heat exchangers require a suitable combination of creep, high-temperature strength, oxidation resistance, and thermal shock. Current heat exchanger designs incur costly pressure drops while only marginally increasing heat transfer. The ability to manufacture complex geometries is needed to reduce this wasteful pressure drop. However, conventional material and manufacturing methods cannot achieve this combination of material properties and complex geometries.



Researchers at Sandia National Laboratories have identified thermal and structural properties of advanced refractory high-entropy alloys (RHEAs) as candidates for high-temperature heat exchangers enabled by combined additive and substractive manufacturing. This technology achieves near net shape geometries that are currently impractical for conventional manufacturing, allowing the end-user to better control function through structure and material design. This is relevant in systems where improvements are limited by current state-of-the-art alloys' performance, such as conventional Ni-based superalloys.

Technical Benefits

- Reduces pressure drop in heat exchangers by 100-500%
- Extends high temperature allowable stress
- Achieves near net shape manufacturing

Industries & Applications

- Fusion and fission applications
- Refrigeration
- Petroleum refining
- Power plants
- Renewable energy systems

Relevant AM Approaches:

- Laser Engineered Net Shaping (LENS)
- Laser Beam Directed Energy Deposition (LB-DED)
- Laser Beam Powder Bed Fusion (LB-PBF)

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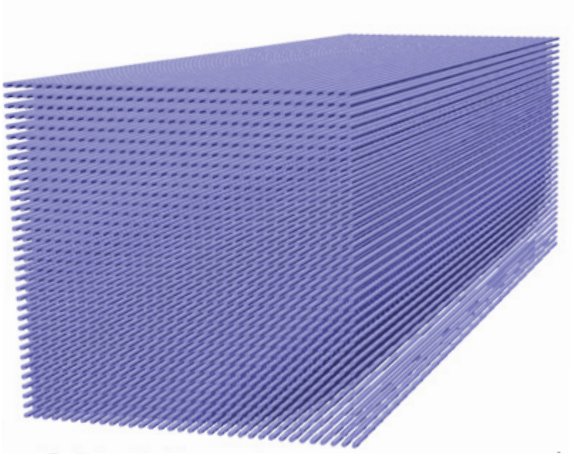
Additional Figures



A perspective end view illustration of an exemplary compact heat exchanger comprising a 35x35 array of small diameter tubes.

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