High-entropy alloys (HEAs) are loosely defined as solid solution alloys that contain five or more principal elements in equal or near equal atomic percent. The ideal configurational entropy of an equimolar solid solution increases with the logarithm of the total number of components in the alloy. HEAs and the more broadly-defined multi-principal-element alloys (MPEAs) represent a major paradigm shift in alloy design and are reported to have a combination of properties that include high strength, high toughness, and excellent creep, fatigue, wear, corrosion and irradiation resistance. These properties make them attractive for use in extreme environments.

The high-entropy concept has now been extended from structural materials to commercial alloys in testing. The microstructure, mechanical properties, oxidation behavior and aqueous corrosion were evaluated. The microstructure, mechanical properties, oxidation behavior and aqueous corrosion were evaluated.

NETL designed a corrosion resistant HEA (A36) based on CoCrFeNiMo. This is a single phase austenitic alloy. The performance was compared to Haynes Multimelt and Hastelloy C276, commercial corrosion resistant alloys. NETL’s A36 HEA performs as well or better than the commercial alloys in testing.

The high temperature oxidation behavior of a FeNiCoCrMn single phase austenitic HEA. Test was done at 750 (not shown) and 850°C. The oxidation resists of NETL HEA-N1 and HEA-IN compare favorably to the commercial superalloy 282.

NETL applied HEA principles to re-design the matrix of gamma prime precipitation strengthened Ni-superalloys. The NETL High Entropy Superalloys (HEA) have good elevated temperature strength compared to conventional alloys used in advanced fossil energy power systems. Evaluation of the performance is continuing.

RESULTS, BENEFITS, & FUTURE WORK

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REFERENCES

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Future work will be placed on further optimizing the microstructure (e.g., balancing the volume fractions of various phases (γ matrix, γ precipitates, MC carbides, M7C3 carbides, and other strengthening precipitates) and thermo-mechanical processing (e.g., refining grain sizes, grain boundary engineering)).

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