Complex Architectures in High-Entropy Superalloy: A Study by Using Atom Probe

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High-temperature turbine of engine in aircraft will be a critical application of high-entropy alloy, named high-entropy superalloy (HESA). A HESA (Ni-3.9Al-22.3Co-11.7Cr-11.8Fe-6.3Ti in wt. %), whose configuration entropy is about 1.58R, has been developed, and its mechanical property is superior to INCONEL-718 alloy. However, its nano/microstructure is lack of in-depth study.

The current work investigated nano/microstructure in this HESA by using atom probe microscopy. Multiscale architectures, from nano precipitates, coarse precipitate, to matrix, have been identified from the reconstruction of atom probe microscopy. A diffused interfacial layer between precipitate and matrix was directly discovered by atom probe. The configuration entropy of this layer can be higher than 1.50R, and these layers stably retained around both coarse and fine precipitates after aging at 900 ˚C. This phenomena indicates that using X-ray diffraction spectrum to estimate lattice mismatch between precipitate and matrix is not always meaningful because, in this alloy, the precipitates are surrounded by the transition layer, instead of the matrix. Moreover, these results could elucidate the mechanical property and excellent thermal stability of this HESA.