An Introduction to High Entropy Alloys and Recent Developments

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ABSTRACT

In the last decade, a new class of materials, called high-entropy alloys (HEAs), has been proposed and developed. The great potential of HEAs has been exemplified by the AlxCoCrCuFeNi system, which has been studied, since the HEA concept was introduced in 2004. The great interests are still paid even nowadays. The alloy-design strategy of combining multiple elements in near-equimolar ratios has shown great potential for producing exceptional engineering materials, often known as “HEAs”. Understanding the elemental distributions, and, thus, the evolution of the configurational entropy during solidification, are the goal of the present research. The case of the Al1.3CoCrCuFeNi model alloy is examined, using integrated theoretical and experimental techniques, such as ab initio molecular-dynamics simulations, in-situ neutron levitation and scattering experiments, synchrotron X-ray diffraction, high-resolution electron microscopy, and atom-probe tomography. It is shown that even when the material undergoes elemental segregation, precipitation, chemical ordering, and spinodal decomposition, a significant amount of disorder remains, due to the distributions of multiple elements in the major phases. The results suggest that the high-entropy-alloy-design strategy may be used to develop a wide range of complex materials, which are not limited to single-phase solid solutions. The
integrated experimental and theoretical techniques, discussed here, are particularly well-suited to studying partially-ordered materials, produced using the high-entropy-alloy design strategy.


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