Editorial

Preamble for the “Feature Paper Collection of Advanced Research on Alloys”

Nikki Stanford

Future Industries Institute, University of South Australia, Building MM, Mawson Lakes Campus, Mawson Lakes, SA 5095, Australia; nikki.stanford@unisa.edu.au

This year, several hot topics have emerged in alloy research and design; we have collected a few of these in this feature paper collection for your enjoyment. One key area is additive manufacturing, where we are seeing a huge spike in the number of papers being published, as well as a steep rise in the variety of printers being developed and commercialized. The paper by Psihoyos and Lampeas (Contribution 1) included in this feature paper collection studies laser powder bed fusion and provides extensive printability maps for that particular printer. The authors also apply a modeling approach to allow porosity prediction.

Another prominent research area in alloy design is high-entropy alloys (HEAs). There are three HEA papers in this collection. Mohamed et al. (Contribution 2) study the oxidation of an HEA, a critical property of this alloy class when used in high temperature applications. The use of HEAs and other chemically complex alloys is also discussed in this collection by Tsakiropoulos (Contribution 3); also included is a fantastic article by Rajendrachari (Contribution 4). The author highlights the increasing interest in HEAs and reviews both the experimental and theoretical status of this field. The breadth of this field is increasing rapidly, and one can now find research papers on topics such as the wear [1], fatigue [2], and thermal spray [3] of HEAs. The interest in this topic is clear, with Rajendrachari’s article being viewed several thousand times already. If you are interested in complex systems, I also recommend the paper by Tankov et al. (Contribution 5), who experimentally examines complex BCC alloys with ultra-high-temperature melting points.

This collection also includes some quite novel alloy design papers. Mukhachev et al. (Contribution 6) present a paper on alloy production for nuclear reactor applications, while Dedyukhin et al. (Contribution 7) have studied solute solubility in Ga–In alloys. For those metallurgists who are more interested in conventional alloys, Luo et al. (Contribution 8) present a comprehensive paper on both computational and experimental data on interdendritic segregation and casting behaviors in a steel alloy. Despite being so well studied for many decades, steel is still a hot topic in the scientific community. Our most highly viewed paper in this collection is on nickel alloying in steel (Contribution 9). If ferrous metallurgy is of interest, the paper by Ferreiros et al. (Contribution 10) on the thermo-mechanical processing of Fe-based superalloys will be a great read. Another traditional manufacturing technique discussed in this collection of papers is powder metallurgy—Bolzoni et al. (Contribution 11) describe the successful production of a complex titanium alloy using conventional powder metallurgical techniques.

Finally, arguably the most exciting area in alloy design and behavior is computational methods. But experimental scientists may ask why we should use computational methods at all; what value could they add? Fundamentally, computational methods, particularly at the atomic scale, provide insights on a scale that is not experimentally possible. The properties of crystalline alloys can be significantly altered by the presence of point, line, and surface defects, and we know that internal interfaces such as grain boundaries govern an alloy’s response to chemical, mechanical, and thermal forces. Advances in microscopy such as high-resolution transmission electron microscopy and atom probe tomography provide
compelling experimental evidence as to the structure and composition of these boundaries and defects, but these techniques have their limitations. In particular, the atomic-scale transmission electron microscopy of interfaces is only possible on special boundaries with perfectly symmetrical crystallographies. These do not represent the majority of boundary types in engineering materials. In fact, engineering properties are largely unaffected by these special boundaries. It is the “real” boundaries, those with irrational crystal rotations on high-order planes, that determine critical properties such as strength and recrystallization kinetics. Thus, the most important type of boundaries must be interrogated computationally. Atomistic simulations not only provide invaluable insights into the local structure, charge distribution, and chemical environment of grain boundaries and interphase interfaces, but can also provide extensive information on the energetic aspects of interfaces and deformation behavior. Within our feature paper collection, we have three quite different approaches to studying materials using computational methods. Beyerlein’s group utilize crystal plasticity methods to study twinning in magnesium (Contribution 12), while Yazdani and Vitry (Contribution 13) use molecular dynamics to study deformation in FCC alloys. Both of these articles have received significant attention, having been viewed by over 1000 scientists worldwide. In their article, Weissker and Calvo (Contribution 14) demonstrate how ab initio methods can be used to study the optical properties of alloys. We hope you enjoy reading these feature articles in Alloys (ISSN 2674-063X).

List of Contributions


**Conflicts of Interest:** The author declares no conflicts of interest.

**References**


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