

# HEA 2019: Exploring Recent Advances in a Rapidly Growing Field

Daniel Miracle



High entropy alloys (HEAs) are made from concentrated blends of five or more principal elements, changing a 5,000-year paradigm for alloy development, which started with the Bronze Age and uses a single dominant element as a base with small alloying additions to improve properties. This conventional approach has transformed civilizations, but there are signs that it's reaching natural limits, since there are no new stable elements to give new alloy bases with significantly better properties than existing alloys. High entropy alloys present hundreds of billions of new bases to explore, and their jumbled atomic structures can also give unexpected new mechanisms and attractive new properties to fuel industrial advancements. There has been extraordinary growth in scientific studies to explore new compositions and to understand new phenomena, and increasing commercial interest to establish potential engineering applications.

The World Congress on High Entropy Alloys (HEA 2019) will be held November 17–20, in Seattle, Washington, to present and discuss the most recent ideas and results in this fast-growing field. HEA 2019 will address this expanding field broadly—it will include the latest advances in single-phase and multi-phase metallic, intermetallic, and ceramic high entropy materials intended for structural and functional applications. Seven major themes in the technical program include: alloy design and exploration;

computational modeling and simulation; fundamental theory and mechanisms; mechanical properties; functional properties; processing; and applications. New ideas for industrial applications will also be covered, including high-temperature structural materials, lightweight structural alloys, oxidation and corrosion resistant materials, irradiation resistant alloys, bio-metallic implants, hydrogen storage, tribology and wear resistance, hard-face coatings for cutting tools, and shape memory alloys. Advances in emerging concepts such as machine learning, high throughput computations, high throughput experiments, and material processing (including additive manufacturing) will be highlighted. These ideas and technologies are essential not only for HEAs, but are also pushing the boundaries of how the field of materials science conceives, characterizes, and develops new candidates.

The congress features three plenary speakers (Chain Tsuan Liu, City University of Hong Kong; Dierke Raabe, Max-Planck-Institut für Eisenforschung GmbH; and Oleg Senkov, UES Inc.) who are thought leaders in the compositional and microstructural development of HEAs based on 3D transition metals and on refractory elements. Strategies highlighted in these talks include solid solution hardening, precipitation strengthening, and the intentional design of metastable phases and microstructures that transform during deformation to enhance properties.



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While the bulk of the technical program is built from more than 170 contributed abstracts representing 26 countries, the lineup of additional keynote and invited speakers includes many international leaders representing a range of scientific disciplines:

- Donald Brenner, North Carolina State University
  - William Curtin, EPFL/STI-IGM-LAMMM
  - Michael Gao, National Energy Technology Laboratory
  - Easo George, Oak Ridge National Laboratory
  - Bronislava Gorr, University of Siegen
  - Horst Hahn, Karlsruhe Institute of Technology
  - Haruyuki Inui, Kyoto University
  - Zhaoping Lu, University of Science and Technology Beijing
  - Alfred Ludwig, Ruhr-University Bochum
  - Gregory Olson, Northwestern University
  - Eun Soo Park, Seoul National University
  - Robert Ritchie, University of California, Berkeley
  - John R. Scully, University of Virginia
  - Cemal Cem Tasan, Massachusetts Institute of Technology
  - Chris Woodward, Air Force Research Laboratory
  - Fan Zhang, CompuTherm LLC
- Participants at HEA 2019 will gain access to the most up-to-date ideas and

advancements in the field from all over the world. Vibrant oral and poster presentations will stimulate new ideas that can be further developed through networking opportunities in a multi-disciplinary environment. Scientists and engineers from industry, academia, and government will explore and discuss opportunities to form partnerships and collaborations on this promising technology. The program also features an accent on diversity and active contributions from young professionals, supporting TMS’s aspirational goals (to learn more about TMS Aspires, TMS’s new strategic plan, visit [www.tms.org/TMSAspires](http://www.tms.org/TMSAspires)). Closing out the congress is a tour of the massive Boeing assembly plant—the world’s largest building by volume—where attendees will have the chance to see familiar Boeing planes in production.

High entropy alloys offer transformational possibilities and major new challenges. Scientists and engineers all over the world are responding to these challenges with new ideas, new alloys, and new experimental and computational methods. The goal of HEA 2019 is to invigorate the spirit of exploration, of finding new and unexpected results by asking bold new questions and searching for new answers.

**Daniel Miracle is a senior scientist at the Air Force Research Laboratory and chair of the HEA 2019 organizing committee. A 2018 TMS Fellow, Miracle is currently the chair of the TMS Structural Materials Division.**



## Registration is Open for HEA 2019

Don’t miss the first World Congress on High Entropy Alloys (HEA 2019)—a new, cross-disciplinary technical forum designed to share the latest research advances in materials with high configurations entropy.

**When:** November 17–20, 2019

**Where:** Hyatt at Olive 8, Seattle, Washington, USA

Book your housing by October 25!

**How to Participate:** Register before October 7, 2019, to take advantage of discounted rates.

**Learn More and Register Today:** [www.tms.org/HEA2019](http://www.tms.org/HEA2019)

**Stay for the Tour:** Enhance your HEA 2019 experience by participating in the Boeing Future of Flight Tour on Thursday, November 21. Registration is free, but tour size is limited. Additional details can be found on the congress website.

