Preface

The development of new materials drives the progress of human society, which experienced the stone age, the iron age, the steam engine age, and the information age. Metal and alloys were considered as state of art materials for structural applications for centuries. For example, during the XX century progress in metallurgy has enabled the humanity to build cars, planes, and space rockets, i.e. to create modern transportation industry. However, currently metallic alloys face severe competition from other materials like plastics, ceramics, composites, etc. To widen the application range of metals and alloys, we need to obtain alloy materials with superior combinations of different properties for daily life, national defense, and outer space exploration.

In recent years, “high-entropy alloys (HEAs)” or “complex concentrated alloys (CCAs)”, consisting of equal or near equal atomic multi-elements, have attracted a large number of scholars from different fields. HEAs/CCAs belong to central, weakly explored, areas of multicomponent phase diagrams, and thus can have unique structures and properties. For example, it was found that they can have superior mechanical properties in a wide temperature range (from cryogenic to extremely high temperatures). Recently, it has been shown that they also demonstrate promising functional properties. Moreover, extension of HEAs/CCAs concept to other, non-metallic materials has brought us new classes of materials like high entropy ceramics, high entropy intermetallics, etc. These new materials can also have unique structural and functional properties.

Therefore, International Conference and Annual School of Young Scientists: “Synthesis, structure and properties of high entropy materials” is organized and held at Belgorod State University. The main aim of the school is to gather the young scientists interested in HEAs and related materials and give them the platform to listen to established international experts in the field and share their own research. The first School was successfully held on October 9-11, 2019 with 17 invited speakers and more than 60 attendees. Despite the Coronavirus pandemic, the next meeting was held on October 14-16, 2020. The Conference and School has attracted 11 invited speakers and more than 80 young scientists. The topics of interest included:

- High- and medium-entropy alloys, complex concentrated alloys, methods of their preparation, structure, mechanical and functional properties, phase stability and structural phase transformations, deformation mechanisms, diffusion and ordering processes.
- High-entropy and complex concentrated coatings, methods of their preparation, structure, and properties.
- High-entropy ceramics, methods of their preparation, structure, and properties.
- Research and development of new complex concentrated materials for technology and medicine, including nanostructured materials, microstructural design of multicomponent materials, prospects for practical application.
- Advanced methods of obtaining and processing metallic and non-metallic materials for structural and functional applications, including additive technologies, new casting, powder metallurgy, welding, surface treatment technologies.
- Other promising directions in the development of new metallic and non-metallic materials.
- Computational modeling of complex concentrated alloys, coatings, and ceramics in different environments.

The selected works presented at the International Conference and Annual School of Young Scientists 2020: “Synthesis, structure and properties of high entropy materials” are published in this special issue. The School was supported by Russian Science Foundation Grant № 19-79-30066.

Organizing committee:
- Gennady Salishchev
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