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High-Entropy Materials and their applications

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ABSTRACT

"High-Entropy Materials (HEMs)" has become an emerging field since the high-entropy alloys (HEAs) concept was disclosed in 2004. Total number of journal papers on HEMs has exceeded 3000 from 2004 to the end of 2018. The HEAs are featured with high entropy effect by which their high mixing entropy can enhance the formation of solution-type phases and avoid the formation of many complex and brittle intermetallic compounds. This simplification of constituent phases renders HEAs feasible to be synthesized, studied, and used. Another three core effects, i.e., severe lattice distortion, sluggish diffusion and cocktail, accompanying high entropy effect have significant influences on kinetics, microstructure and properties of HEAs. Thus, HEAs have a wide range of microstructure and properties. In 2005, the concept of HEAs was first extended to HEMs by the publication of research on high-entropy nitrides which was formed by reactive magnetron sputtering. Afterwards, high-entropy ceramics and composites were designed and researched based on HEAs concept and core effects. It has been widely accepted that a HEM with suitable composition design as well as suitable process design will exhibit superior properties in mechanical, physical, chemical or functional aspect and thus have advanced applications. In this talk, several possible breakthrough applications are pointed out and emphasized. They include materials for turbine engines, molds and dies, cutting tools, hard coatings, hardfacings, and radiation damage resistant parts, etc.