High-entropy alloys - from the hype to applications

Walter Steurer, Prof. em. Department of Materials, ETH Zurich

More than one thousand publications appeared since the concept of high-entropy alloys (HEAs) was introduced by Jien-Wei Yeh (National Tsing Hua University, Taiwan) in the year 2002. The rationale behind this concept was that multiprincipal solid solutions of five or more metallic elements would be stabilized by the high mixing entropy, what could prevent the formation of intermetallic compounds and phase separation. For the approximately 80 stable metallic elements, of the periodic tablean incredible amount of combinations would be possible, allowing the fine-tuning of physical properties and, perhaps, the discovery of materials with exciting novel properties. The hype did last only a couple of years, then it became clear that things were more complex than originally assumed. Anyway, we know presently a handful of five- to six-component HEAs, which show interesting properties, indeed. For instance, refractory-element HEAs may find aplications as high-temperature structural materials because of their superior mechanical properties. On the nanoscale they outperform as well all known materials with regard to strength in combination with ductility.