

Topic: Changes in microstructure and diffusion behaviour by adding a further element to four-component high-entropy alloys

High-entropy alloys, i.e. multicomponent alloys with a large number of constituting elements in equiatomic or nearly equiatomic composition, attract an increased attention as a potential structural material due to attractive mechanical and physical properties. It is anticipated that when the number of elements is equal or larger than 5 and the concentration of each of the alloying elements is between 5 and 35 atomic percent (at.%), the high mixing entropy can significantly reduce the Gibbs free energy and stabilize solid-solution-like phases with relatively simple crystal structures, compared to intermetallic phases, especially at high temperatures [1].

Hereby, we are investigating radiotracer diffusion of the constituting elements in $\text{Al}_x\text{CoCrFeNi}$ and $(\text{CoCrFeMn})_{100-x}\text{Ni}_x$ alloys and thus contributing to a debate about the hypothetical sluggish diffusion phenomenon in HEAs. On the one hand, the impact of the high-entropy effect in pure FCC matrix, i.e. the $(\text{CoCrFeMn})_{100-x}\text{Ni}_x$ alloys, is investigated. On the other hand, diffusion is measured in $\text{Al}_x\text{CoCrFeNi}$ which correspond to a mixture of FCC, BCC and B2 phases depending on the Al content x . As the Al content x in the $\text{Al}_x\text{CoCrFeNi}$ alloys is increased, a two-phase FCC+BCC microstructure replaces the single phase FCC one at $x > 0.3$ and the material becomes single phased BCC at $x = 2$ [2]. A careful microstructure examination using XRD, SEM and EBSD analyses allows quantifying the measured diffusion profiles in terms of two separate contributions to long-range diffusion in FCC and BCC phases.

[1] Zhi Tang, Tao Yuan, Che-Wei Tsai, Jien-Wei Yeh, Carl D. Lundin, Peter K. Liaw. Fatigue behavior of a wrought $\text{Al}_{0.5}\text{CoCrCuFeNi}$ two-phase high-entropy alloy. *Acta Materialia*, Volume 99, 15 October 2015, Pages 247–258.

[2] Yih-Farn Kao, Ting-Jie Chen, Swe-Kai Chen, Jien-Wei Yeh. Microstructure and mechanical property of as-cast, -homogenized, and -deformed $\text{Al}_x\text{CoCrFeNi}$ ($0 \leq x \leq 2$) high-entropy alloys. *Journal of Alloys and Compounds*, Volume 488, Issue 1, 2009, Pages 57-64.