Time & Location: April 1, 2019 at 9:00 AM in Research 1 Conference room # 103
Title: Fundamental core effects in Co-Cr-Fe-Ni based high entropy alloys

High entropy alloys (HEAs) are near equiatomic multi-element alloys (MPEAs) which are different from traditional solvent-based multicomponent alloys. Based on initial work by Yeh and co-workers, they were proposed to exhibit four core effects: high entropy, sluggish diffusion, lattice distortion, and cocktail effect. Present work investigates two of the four core effects, i.e. high entropy and sluggish diffusion effects, in CoCrFeNi based transition metal high entropy alloys. Solid-solid diffusion couple approach was adopted to investigate, these core effects. Experimental results contradict the high entropy effect based on thermodynamics analysis: that the HEAs with low entropy of mixing may be thermodynamically more stable than the HEA of similar constituent elements with high entropy of mixing. In such cases, enthalpy of mixing can also play a vital role in stabilizing the HEA with lower entropy of mixing. Measurement of diffusion coefficients (i.e. both interdiffusion and tracer diffusion coefficients) in HEAs and its comparison with conventional solvent-based multicomponent alloys suggests that diffusion is not always sluggish in high entropy alloys. Contrary to previous findings, larger fluctuations in lattice potential energy (LPE) of an alloy may not always result in anomalously slow diffusion, in comparison to alloy systems which exhibits smaller fluctuation in LPE. Findings from his dissertation provide a controversial understanding of high entropy alloys, and alloy development strategies in the future for the most aggressive applications such as those found in gas turbines and nuclear reactors. As these applications will certainly require the knowledge of high-temperature stability and nature of diffusion under extreme application environment.

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Approved for distribution by Yongho Sohn, Committee Chair, on March 18, 2019.

The public is welcome to attend.