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Comparing the Effects of Annealing and on the Magnetic Properties of High Entropy Alloys LIZABETH QUIGLEY, DUSTIN GILBERT, NAN TANG, WALKER BOLDMAN, CAMERON JORGENSEN, RMI KOCH, DANIEL O'LEARY, HUGH MEDAL, PHILIP RACK, University of Tennessee — High entropy alloys often have unique magnetic properties but are challenging to predict or design. In this work, we prepared two wafers made of Cr, Mn, Fe, and Ni using room temperature combinatorial sputtering. This technique results in a compositional gradient across the wafer, allowing a range of samples to be prepared at once. The as-grown wafer showed a single BCC structural phase and no chemical ordering. The second wafer was annealed at 600C and showed large single-phase regions with BCC and FCC ordering. The difference between the two wafers allows for the effects of structural ordering and composition to be separated. The as-grown wafer showed superparamagnetic tendencies at higher temperatures, which resolved to both ferromagnetic and antiferromagnetic phases at low temperatures; exchange bias including loop shift and enhanced coercivity was observed. The as-grown wafer also showed a divergent coercivity at temperatures below 50K. The annealed wafer showed a larger Curie and saturation magnetization. However, the temperature dependence of the coercivity observed in the as-grown wafer was all but suppressed. This work shows the important role of ordering in high entropy alloys and explores a new parameter space which is inaccessible by traditional bulk synthesis techniques. Understanding the roles of composition and processing, and how they affect their properties, is critical for improving this field and eventually designing these materials.

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