

The Effect of Molybdenum on the Alloy Properties of the CoCrNiFeMnNb System

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ABSTRACT

The authors studied the influence of Mo and C on the properties of the CoCrNiFeMnNb alloy system. Quasi-high-entropy alloys (QHEAs) were smelted by partially using ferroalloys in the charge, unlike classical high-entropy alloys (HEAs). The Mo content was 2 and 4% mass. The C content was 0.45% mass in the experimental alloys. The C content was determined based on the initial content in the charge. The experimental alloy microstructure was represented by a solid FCC-type solution; Laves phases of various compositions; Me1Me2-type intermetallics; carbides Nb_{0.8}, Cr_{0.2}C, and Mo_{0.5}NbC; and μ-phase NbCo₂. All experimental alloys had higher hardness, strength, and wear resistance than the alloy without Mo and C. Increasing the Mo content in the alloy to 4% mass increased the hardness and, in particular, the wear resistance of the alloy. Strengthening the alloy with elements Mo and C is associated with forming a finer grain. Grain growth was limited by implementation phases, as well as dispersion strengthening due to solid implementation phases of various origins being formed.

KEYWORDS

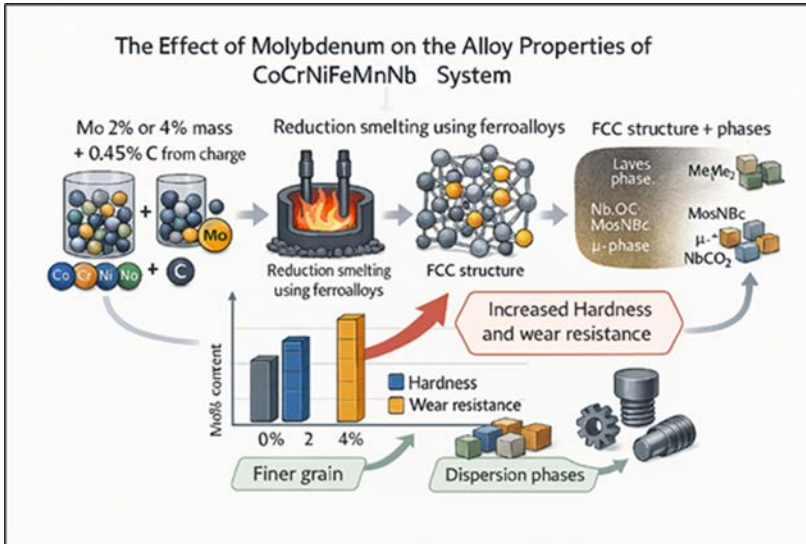
Quasi-High Entropy Alloy (QHEA), Phases, Hardness, Molybdenum, Strength, Structure, Wear Resistance

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INTRODUCTION

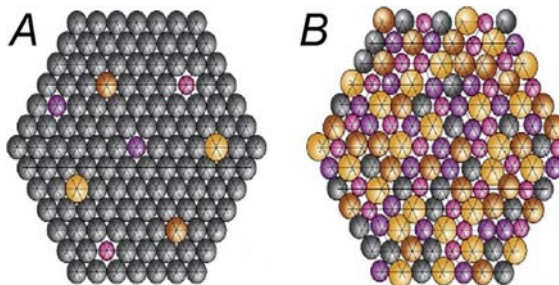
Figure 1. Influence of Molybdenum on the Alloy Properties of the CoCrNiFeMnNb System



Note. Co = cobalt; Cr = chromium; Ni = nickel; Fe = iron; Mn = manganese; Nb = niobium; Mo = molybdenum; C = carbon; O = oxygen; FCC = Face-Centered Cubic.

High-entropy alloys (HEAs) have high performance properties. Therefore, they are of great interest to industries despite the high cost and complex technology associated with their production. Thus, multicomponent alloys containing several components in equal atomic ratios were manufactured by Cantor et al., (2004) using complex technology by casting and molding from a melt. At the same time, the researcher Yeh with colleagues (2007) find that HEAs are quite simple to analyze and control, and they might be processed as traditional alloys. There exist many opportunities to create novel alloys, better than traditional ones in a wide range of applications. The fundamental difference between HEAs and classical alloys is the absence of a base element such as the iron in steel. Figure 2 depicts differences between the structural formation of a HEA and that of a classical alloy.

Figure 2. Structure Formations of a Classical Alloy and a High-Entropy Alloy



Note. Panel A depicts a classical alloy and panel B depicts a high-entropy alloy. From “Microstructural Development in Equiatomic Multicomponent Alloys,” by B. Cantor, I. T. H. Chang, P. Knight, and

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