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Solid Solution Strengthened Fe Alloys

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ABSTRACT

Iron (Fe)-based alloys (such as steel) are widely used structural materials in industry. Numerous methods have been applied to improve their mechanical properties. In this study, we used a technique know as magnetron sputtering to deposit various Fe-based binary alloy coatings to investigate the influence of solutes on solid solution hardening. Several factors contribute to the solid solution hardening of the alloys, such as composition, atomic radius, modulus, and lattice parameter. After preliminary calculations and analysis, we selected several solutes, including molybdenum (Mo), niobium (Nb), and zirconium (Zr). The compositions of solutes were varied to be 2.5, 5, 8 atomic %. Our nanoindentation hardness measurements show that among the three solid solution alloys, Fe-Zr has the highest hardness. The influences of solutes on microstructural and hardness evolution in these solid solution alloys are discussed.

KEYWORDS

Fe Alloys, Mechanical Properties, Hardness, Sputtering Deposition, Thin Films, Alloy Design