

Hea coatings: Design, processing, corrosion resistance.

Hana Kim*

Department of Materials Engineering, SeoulTech University, South Korea

Introduction

This research explored how annealing affects sputtered FeMn-CoCrNi high-entropy alloy thin films. They found that specific heat treatments significantly improved the films' microstructure, leading to enhanced corrosion resistance. This really means annealing offers a crucial pathway to fine-tune these materials for superior performance in challenging environments [1].

This work investigated how adding different amounts of titanium influenced FeCoNiCr-Ti high-entropy alloy films, focusing on their microstructure and resistance to corrosion. This indicates that carefully controlling the Ti concentration significantly impacts the film's properties. What this really means is that it allows for precise optimization of its protective capabilities for diverse applications [2].

This study delves into amorphous Fe-Mo-Cr-C thin films, deposited using magnetron sputtering. Researchers observed that these films exhibited excellent corrosion resistance, which is largely attributed to their amorphous structure and specific elemental composition. This highlights the substantial potential for designing highly protective coatings using this particular material system [3].

This paper examined CoCrFeNiMo high-entropy alloy thin films, fabricated using magnetron sputtering, focusing on their corrosion resistance and mechanical strength. The researchers found that these films possess an excellent combination of properties, making them promising candidates for protective coatings. This is especially true for demanding environments where durability is key [4].

This paper investigated Al_xCoCrFeNi high-entropy alloy films produced via magnetron sputtering, analyzing their microstructure and corrosion behavior. They discovered that by adjusting the aluminum content, the films' corrosion resistance could be significantly tuned. This offers a clear pathway for designing coatings with specifically tailored protective properties to meet various needs [5].

This article focuses on CoCrFeMnNi high-entropy alloy coatings, produced using magnetron sputtering, and examines their mi-

crostructure, mechanical properties, and corrosion resistance. They demonstrated that these sputtered coatings exhibit superior performance, offering robust protection and enhanced durability. This is especially important for various industrial uses where material longevity is paramount [6].

This article investigates the microstructural changes and improved corrosion resistance of AlCoCrFeNi high-entropy alloy thin films after annealing. They found that heat treatment plays a crucial role in optimizing the film's properties. This leads to significantly enhanced corrosion protection, a vital aspect for ensuring long-term applications are successful [7].

This research explored WTaMoNb high-entropy alloy films fabricated through magnetron sputtering, investigating their structural characteristics and corrosion resistance. These investigations revealed that these films exhibit excellent corrosion protection. This suggests that this specific alloy design, when combined with efficient sputtering, offers a promising route for developing highly durable coatings [8].

This study explored CoCrFeNi high-entropy alloy coatings, enhanced by nitrogen doping through magnetron sputtering, examining their mechanical properties and corrosion resistance. They found that introducing nitrogen significantly improved both the hardness and the corrosion protection of the films. This provides an effective way to engineer more durable surfaces for demanding applications [9].

This article investigates nanocrystalline FeCrNiMnTi thin films, produced using magnetron sputtering, focusing on their microstructure and corrosion resistance. The research reveals that these films offer strong corrosion protection. This highlights how careful control over the sputtering process and alloy composition can lead to high-performance materials for even the most demanding applications [10].

Conclusion

Research consistently explores high-entropy alloy thin films for their superior properties, especially corrosion resistance. Many

*Correspondence to: Hana Kim, Department of Materials Engineering, SeoulTech University, South Korea. E-mail: hana.kim@seoultech-labs.example.com

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studies focus on magnetron sputtering as a primary fabrication method, demonstrating its versatility in producing various HEA compositions. Post-deposition treatments, like annealing, are critical for optimizing film microstructure and enhancing performance. For instance, annealing FeMnCoCrNi and AlCoCrFeNi HEA films significantly improves both microstructure and corrosion resistance, indicating a precise way to fine-tune these materials for demanding environments. Compositional tuning is another powerful approach. Adjusting titanium content in FeCoNiCr-Ti alloys or aluminum content in AlxCoCrFeNi films allows for targeted optimization of protective capabilities. The introduction of nitrogen into CoCrFeNi coatings, for example, boosts both hardness and corrosion protection, creating more durable surfaces. Beyond compositional and process variations, specific HEA systems like CoCrFeNiMo, CoCrFeMnNi, WTaMoNb, and nanocrystalline FeCrNiMnTi have been investigated. These films consistently show excellent corrosion resistance, often coupled with desirable mechanical properties. Even amorphous Fe-Mo-Cr-C thin films, deposited via magnetron sputtering, exhibit outstanding corrosion resistance due to their unique structure and elemental makeup. What this really means is that a multifaceted approach involving precise alloy design, controlled deposition techniques, and strategic post-processing allows for the creation of high-performance HEA coatings. These materials offer robust protection and enhanced durability, making them promising candidates for a wide range of industrial applications.

References

1. Cai YH, Chu KC, Chen CH. Effect of annealing treatment on the microstructure and corrosion resistance of sputtered FeMnCoCrNi high-entropy alloy thin films. *Thin Solid Films*. 2023;785:140109.
2. Liu M, Liang G, Wang Z. Influence of Ti concentration on the microstructure and corrosion resistance of FeCoNiCr-Ti high-entropy alloy films. *Vacuum*. 2022;206:111520.
3. Liu YM, Yu ZF, Zhou JX. Microstructure and corrosion behavior of magnetron-sputtered amorphous Fe-Mo-Cr-C thin films. *J Mater Res Technol*. 2024;29:7453-7463.
4. Tang X, Wang S, Ma Y. Corrosion resistance and mechanical properties of CoCrFeNiMo high-entropy alloy thin films prepared by magnetron sputtering. *Surf Coat Technol*. 2021;422:127538.
5. Ding Y, Guo Y, Wang S. Microstructure and corrosion performance of Alx-CoCrFeNi high-entropy alloy films prepared by magnetron sputtering. *Corros Sci*. 2020;173:108795.
6. Wu L, Ma X, Ma X. Microstructure, mechanical properties and corrosion resistance of high-entropy alloy *CoCrFeMnNi coatings prepared by magnetron sputtering*. *Surf Coat Technol*. 2019;377:124898.
7. Wang S, Tang X, Wang J. Microstructural Evolution and Enhanced Corrosion Resistance of AlCoCrFeNi High-Entropy Alloy Thin Films through Annealing. *Adv Eng Mater*. 2022;24(1):2100877.
8. Xu X, Cao Y, Zhang Y. Structure and corrosion behavior of WTaMoNb high-entropy alloy films deposited by magnetron sputtering. *J Alloys Compd*. 2023;968:172186.
9. Wu C, Li L, Li Y. Corrosion resistance and mechanical properties of CoCrFeNi high-entropy alloy coatings doped with nitrogen by magnetron sputtering. *Appl Surf Sci*. 2020;504:144505.
10. Xu X, Zhang Y, Cao Y. Microstructure and corrosion behavior of nanocrystalline FeCrNiMnTi thin films fabricated by magnetron sputtering. *J Mater Res Technol*. 2021;15:569-577.

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