NITROGEN ION IMPLANTATION IN REFRACTORY HIGH ENTROPY METALLIC GLASSES: STRUCTURAL AND MECHANICAL EFFECTS

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ABSTRACT

High-entropy metallic glasses (HEMGs) integrate the outstanding mechanical and chemical properties of metallic glasses with the complex composition of high-entropy alloys. Among them, refractory high-entropy metallic glasses (RHEMGs) are particularly notable for their excellent thermal stability, oxidation resistance, and superior mechanical properties at elevated temperatures. While extensive research has been conducted on their thermal behavior, mechanical characteristics, and glass-forming ability, ion implantation remains a largely unexplored approach for enhancing their surface properties.

This study examines the effects of nitrogen ion implantation on a thin film of HfMoNbTaTiVWZr, a RHEMG recognized for its exceptional stability and hardness. Although ion implantation has been successfully used to improve hardness and wear resistance in both conventional metallic glasses and high-entropy alloys, its impact on

RHEMGs is not well understood. Previous research has shown that argon ion implantation has little effect on the hardness of this material, indicating high radiation resistance. On the other hand, nitrogen implantation induce significant modifications, such as nitride formation, densification, and alterations in atomic bonding.

Our investigation focuses on how nitrogen incorporation influences hardness, elastic modulus, tribological properties, and fracture resistance. Particular attention is given to nitrogen diffusion, penetration depth, and potential nitride formation. Preliminary results suggest that nitrogen implantation can substantially modify surface characteristics without affecting the bulk properties of the material. These findings offer valuable insights into optimizing RHEMGs for high-performance applications in extreme environments, where improved surface properties are required without compromising structural integrity. Samples with nitrogen incorporated into their structure exhibited increased hardness compared to the untreated alloy, and the introduction of nitrogen altered the material's deformation mechanisms.

REFERENCES

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