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Special Issue Reprint

## Fabrication and Properties of Functional Coatings Under Extreme Conditions

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This Reprint focuses on the fabrication and performance modulation of functional coatings under extreme service conditions, as featured in the "Thin Films and Interfaces" section of *Materials*. It compiles peer-reviewed research presenting advances in the preparation, characterization, protective mechanisms, and engineering applications of thin films and coatings, highlighting coating behaviors in nuclear, aerospace, and marine environments. The core research covers novel preparation methods, growth mechanisms, surface strengthening of alloys, design of multilayer systems, and controllable fabrication of nanostructured high-entropy and composite coatings. Studies in the volume investigate oxidation resistance mechanisms, corrosion resistance regulation, oxidation kinetics in service, and coating–substrate interfacial interactions. Meanwhile, work incorporating molecular dynamics simulations and first-principles calculations reveals the intrinsic links between coatings' composition and structure and their service stability, as well as surface/interface evolution under extreme conditions. These findings provide theoretical insight and technical support for developing and optimizing advanced functional coating materials, offering a valuable reference for researchers in materials science, surface engineering, and extreme-environment material design.

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