Theoretical Investigation of Mechanical Properties of UNS#A97075 Alloy: ab *Initio* Study

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Abstract:

UNS#A97075, a high-strength aluminum-zinc alloy, is widely utilized in industries demanding superior mechanical performance. This study provides a theoretical analysis of the mechanical properties of UNS#A97075 using computational modeling techniques implemented in PTC Mathcad. The research focuses on evaluating the alloy's strength, ductility, elastic modulus, and fatigue resistance under diverse loading and environmental conditions.

Theoretical models for stress-strain behavior, deformation mechanisms, and fracture toughness were developed and solved using Mathcad's computational capabilities. Analytical equations and algorithms were employed to predict yield strength, ultimate tensile strength, and hardness based on microstructural parameters, including grain size and precipitate distribution. The impact of thermal and mechanical treatments on mechanical properties was also modeled, highlighting the influence of heat treatments such as aging and solution treatment.

Results obtained through Mathcad simulations reveal the alloy's high strength-to-weight ratio, excellent fatigue resistance, and remarkable fracture toughness. The study further illustrates the role of intermetallic phase precipitation in enhancing mechanical properties. Computational predictions align closely with existing experimental data, validating the theoretical approach and offering valuable insights into the material's behavior.

This theoretical investigation underscores the potential of computational tools like PTC Mathcad in advancing material science research, enabling the optimization of alloy properties for engineering applications. Future studies are proposed to integrate advanced finite element modeling for more detailed analysis of stress distribution and failure mechanisms.

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