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Microstructural Regulation and Mechanical Properties of MIM 18Ni(300) Maraging Steel: Sintering and Heat Treatment

Conventional preparation methods for 18Ni(300) maraging steel fall short in meeting the near-net-shape forming demands for complex components. While powder injection molding (MIM) offers a viable solution for precision manufacturing of parts with intricate geometries, its as-formed microstructure—lacking plastic deformation—differs markedly from that of traditionally forged materials. Consequently, the effectiveness of strengthening and toughening relies heavily on subsequent heat treatment, and the interplay between sintering densification and microstructure control remains poorly understood.

This study investigates the sintering process parameters and solid solution-aging heat treatment regime of MIM-formed 18Ni(300) maraging steel. The results show that vacuum sintering at 1395 ℃ for 2 hours achieves a material density of 98.5%, nearly reaching full densification. Following a solid solution treatment at 920 ℃ for 1 hour and aging at 490 ℃ for 6 hours, the microstructure features a fine lath martensite matrix with uniformly dispersed nanoscale intermetallic compounds (e.g., Ni_3Ti and Ni_3Mo). This treatment yields a tensile strength of 1691 MPa and an elongation of 3.1%, successfully optimizing both strength and toughness. Additionally, adopting a two-stage solid solution treatment with cryogenic processing further increases hardness to 59.53 HRC, highlighting the combined benefits of martensitic transformation and precipitation strengthening.

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Yes

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