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## Hydrogen embrittlement in additively manufactured ultra-high strength maraging steels: mechanistic understanding and H-tolerant structure design

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**Abstract** The utilization of additive manufacturing technologies, such as laser-powder bed fusion (LPBF), in fabricating maraging steel has gained increasing attention in recent years. However, the strength–hydrogen embrittlement (HE) resistance trade-off is a critical issue that restricts the application of LPBF maraging steel in hydrogen-containing environments. In this work, advanced hydrogen trap characterization and high-resolution electron microscopy techniques have been utilized to probe the hydrogen trapping sites and reveal the mechanisms of hydrogen-assisted cracking in LPBF maraging steel. Furthermore, based on the computational simulation and novel heat treatment processes, a novel strategy for design of a multi-scale and multi-dimensional hydrogen trap network in LPBF maraging steel, which enable simultaneous enhancement of the strength and HE resistance is proposed. This work provides new insight into the design of HE resistance steels fabricated by additive manufacturing and motivates the industrial application of LPBF maraging steels.

**Keywords** Hydrogen embrittlement; Additively manufacturing; Maraging steel; Hydrogen traps.