TECHNISCHE UNIVERSITÄT WIEN

technology offer

Reference M047/2021

Energy-efficient Alloying of Sintered Steels via Smart Masteralloy–Molybdenum Powder System

Sintered steel | Molybdenum alloying | Masteralloy | Powder metallurgy | Low-temperature sintering | High-strength components | Precise alloying

This novel alloying method enables the use of elemental molybdenum (Mo) in sintered steel without high temperatures. A special masteralloy melts during sintering and dissolves Mo into a largely homogeneous phase, enhancing hardness and mechanical strength while reducing energy costs. The approach improves dimensional precision and allows flexible, cost-effective formulation of high-performance sintered components.

background

In powder metallurgy, alloying steel with refractory metals like molybdenum improves strength and heat resistance. However, current approaches require pre-alloyed powders, which are costly and hard to press, or blended elemental powders, which require sintering temperatures above 1250 °C to ensure sufficient homogenization. This leads to expensive equipment and dimensional instability due to swelling. Existing masteralloy methods which simply combine a ferrous base powder with Masteralloy and Mo powders, respectively, fail to homogeneously distribute Mo at lower temperatures. A solution is needed to achieve high performance without those limitations.

benefits

- Enables homogeneous Mo alloying at <1200 °C
- Reduces sintering energy costs and equipment complexity
- Improves hardness and hardenability with lower Mo usage
- Avoids swelling and preserves dimensional accuracy
- Supports flexible, on-demand alloy formulation freely defined by the parts manufacturer

potential applications

High-strength precision components in automotive, aerospace, tooling, and general engineering using powder metallurgy.

inventors

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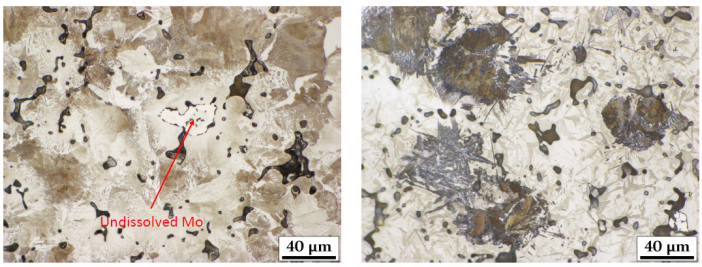
technology

The invention presents a novel two-phase alloying method for sintered steel using a customized, Mo-free iron-based masteralloy that melts at 1120–1180 °C. When mixed with plain iron powder as base and elemental molybdenum powder and heated during sintering, the masteralloy forms a transient liquid phase that dissolves and distributes the Mo uniformly throughout the porous green part. This ensures largely homogeneous alloying at lower temperatures, preserving dimensional stability and enabling efficient processing. The approach avoids the drawbacks of pre-alloyed powders and delivers improved hardness and hardenability - even at surprisingly low Mo concentrations.

Patent application 29952-AT: microstructures



Conventional: Fe-0.85%Mo-0.75%C (231 HV30) *Invention:* Fe-4%MA-0.5%Mo-0.75%C (463 HV30)

Microstructure comparison. Left: Conventional Fe–0.85%Mo–0.75%C (231 HV30), with visible undissolved Mo particles. Right: Invention-based Fe–4%MA–0.5%Mo–0.75%C, showing a dense, homogeneous structure and significantly higher hardness (463 HV30) despite lower Mo content. Both samples sintered at 1150 °C for 60 minutes under identical conditions.

development status

TRL: 4
The method has been validated in laboratory-scale sintering trials with prototype test specimens.

IPR

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