TECHNISCHE UNIVERSITÄT WIEN

technology offer

Reference M055/18

Micro-structure based labeling of multi-stable steel alloys: identification and position sensing

machine hammer peening | material micro-structure | strain-induced martensite | magnetic permeability

A precise cold-forming method applies targeted pressure to multi-stable steel, converting its austenitic structure into martensite. This creates a unique sub-surface pattern with varying magnetic properties. The pattern remains detectable—even after surface finishing—using a non-contact coil sensor. The result: permanent, tamper-resistant part identification and embedded position markers, eliminating the need for labels, magnets, or external markers.

background

Industrial parts need resistant identification and in some applications a position or access information. Today this is done by laser engraving, markers, or adhesive barcodes and Quick Response codes. Visible markers can be removed or copied and can disturb sealing or fitting surfaces; labels degrade under heat, abrasion, ultraviolet light or moisture. Magnetic inserts add parts and can be seen. Laser-based magnetic coding exists but needs dedicated equipment and high processing effort. In contrast, the new technology offers a low-cost, integral and optically invisible solution.

benefits

- Integral code cannot be removed
- Invisible after finishing (optional), yet still machine-readable
- Works on functional surfaces (sealing/fitting) with minimal geometry change
- Smooth surface for easy cleaning
- Variable intensity enables multi-level coding

potential applications

Labeling, traceability markers for metal parts; anti-counterfeit keys/locks; position sensing in actuators; inductive coupling zones

IPR

EP application filed, EP3877556

inventors

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technology

The method uses a numerically controlled tool, such as a machine hammer peening tool, to apply defined local compressive residual stress to alloyed steel surfaces. In metastable austenitic steels, this cold deformation triggers a controlled microstructure change: deformation-induced martensite occurs, increasing magnetic permeability in the treated spots. By controlling the tool path and impact intensity, two-dimensional patterns and graded levels that extend from micrometres to tenths of millimetres into the subsurface can be achieved in the material‘s microstructure. After optional finishing processes such as grinding or PVD coating, the pattern may become visually invisible, but it remains readable. Reading is performed using an electromagnetic sensor head (coils or a Barkhausen sensor) that detects permeability changes during scanning.

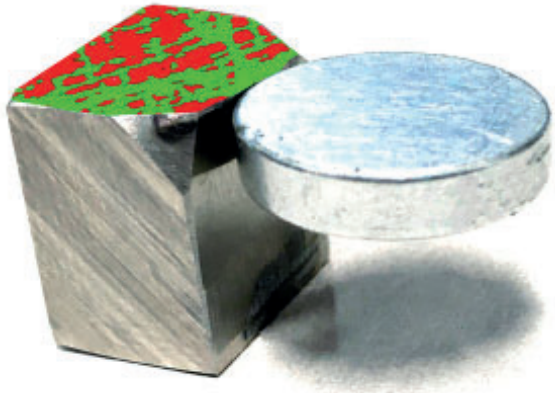

Figure: Ferroimagnetic properties of the hammer peened surface of workpiece with disc magnet (green: deformation induced martensite; red: gamma iron)

development status

TRL 3-4. Laboratory proof of concept

options

Licensing, Co-operation

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