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Methods to produce high performance soft magnetic material (Minnealloy) in bulk (2019-263, Dr. Jian-Ping Wang)

Methods to prepare soft magnetic materials with high magnetization and low coercivity.

IP Status: Pending US Patent; **Application #:** 16/949,038

Applications

- All applications using soft magnetic materials, including hard disks, sensors, motors, generators, transformers, inductors, etc.

Key Benefits & Differentiators

- Industrially relevant, scalable manufacturing methods
- Different pathways to create Minnealloy with different composition and properties
- Optimizable processing parameters to tweak material properties

Key Material Properties

- Lower achievable anisotropy compared to FINEMET
- Excellent magnetic saturation levels
- Favourable permeability, frequency dependence, and coercivity

High performance soft magnetic material

Prof. Jian-Ping Wang's group at the University of Minnesota has developed a number of methods to prepare a new soft magnetic material called Minnealloy. Minnealloys are compounds of Fe-Z-N (Z=C,B,O) with attractive soft magnetic properties, such as **high saturation flux density, low magnetic anisotropy and low coercivity.** These soft magnetic materials have the potential to significantly increase efficiency of energy converters (such as transformers, inductors), lower heat loss, and miniaturize electronic devices. However, broader exploitation has been severely hampered as production of these soft magnetic materials are limited to laboratory scale.

The technology consists of several scalable methods to prepare Minnealloys in bulk to support industrial needs. These fabrication pathways may consist of multiple steps involving conventional manufacturing processes such as arc melting, melt spinning, ball milling, nitriding, annealing, etc. Based on the path and processing parameters chosen, a variety of Minnealloys with composition, and thus properties optimized for different applications can be prepared. Using these methods, for the first time, Dr. Wang's group has demonstrated bulk synthesis of Minnealloy

Technology ID
2019-263

Category
Engineering & Physical Sciences/Materials
Gap Funding/Engineering & Physical Sciences

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- ribbons with specific magnetization >240 emu/g, coercivity <2 Oe, electrical resistivity >1000 μΩ·cm), and
- powders with specific magnetization >220 emu/g, coercivity <2 Oe, electrical resistivity 100 μΩ·cm).

Phase of Development

Proof of concept.

Researchers

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Publications

Carbon and Microstructure Effects on the Magnetic Properties of Fe–CN Soft Magnetic Materials (Minnealloy).
TMS 2020 149th Annual Meeting & Exhibition Supplemental Proceedings. Springer, Cham, 2020.,

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