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Tohoku University
Aichi Steel Corporation

Aichi Steel, Tohoku University Successfully Enhance the Performance of Anisotropic Nd-Fe-B Magnetic Powder

Professor Satoshi Sugimoto of the Graduate School of Engineering of Tohoku University and Aichi Steel Corporation successfully enhanced the performance of Dy-free (dysprosium-free) anisotropic Nd-Fe-B magnetic powder. This is expected to contribute to the accelerating proliferation of electric vehicles and to solving resource problems.

We have developed electric an axle for electric vehicles that is 40% smaller and lighter than earlier products*1. This newly developed magnetic powder makes it possible to further reduce the size (10%) and cost of electric axles, thereby contributing to the rapid development of an electrified society.

Magnetic Powder Manufacturing Process and Development Points

(1) Tohoku University provided knowledge based on advanced analysis technology for application during the multiple heat treatment processes that utilize reactions between alloys and hydrogen, a manufacturing process for magnetic powder used in MAGFINE® (a trademark of Aichi Steel) Dy-free Nd-Fe-B bonded magnets*2. Aichi Steel verified this technology, and the two parties jointly developed the following result:
  (i) Technology that transforms a powder from a polycrystalline structure to a monocrystalline structure by controlling the heat treatment temperature and pressure in a hydrogen decrepitation treatment*3 process
  (ii) Technology to achieve a high degree of alignment of the orientation of the crystals in the magnetic powder using a d-HDDR treatment*4 process

(2) As a result of (1) above, a 15% increase in magnetization while maintaining high coercivity*5 was achieved.

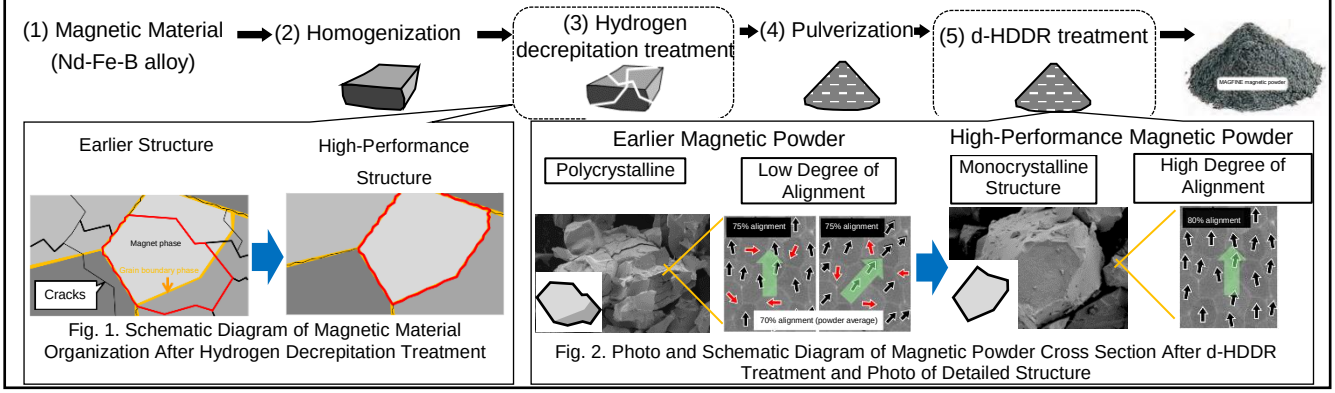

Fig. 1. Schematic Diagram of Magnetic Material Organization After Hydrogen Decrepitation Treatment

Fig. 2. Photo and Schematic Diagram of Magnetic Powder Cross Section After d-HDDR Treatment and Photo of Detailed Structure

Dy-free bonded magnets made from this magnetic powder can be used not only in electric axles for EVs, but for auxiliary motors used in consumer electronics and automobiles and various other applications as well. Consequently, they can play a role in CO_2 emissions reduction technologies and contribute to the rapid development of a smart society.

*1. https://www.aichi-steel.co.jp/ENGLISH/20210107_news_Eng.pdf

*2. Nd-Fe-B bonded magnets (MAGFINE®): Magnets formed from anisotropic Nd-Fe-B magnetic powder by molding with various types of plastic. Aichi Steel conducted independent development starting with magnetic powder and has achieved integrated production up to bonded magnets.

*3. Hydrogen decrepitation treatment: A process where hydrogen is used to form cracks inside a magnetic material (Nd-Fe-B alloy) and crush it.

*4. d-HDDR treatment: A process where heat treatment is performed in a controlled hydrogen atmosphere to achieve a high-performance magnetic powder.

*5. Coercivity: The strength of an external magnetic field in the opposite direction needed to restore a magnetized material to a demagnetized state. For Nd-Fe-B magnets, coercivity is also used as an indicator of heat resistance.