Technical Committee on Research Trends in the Development and Application of High-Performance Permanent Magnet Materials

Technical Committee on Magnetics

1. Objective

Demand for high-performance rare-earth permanent magnets is expected to increase so that carbon neutrality can be achieved. Securing rare earth resources and resolving supply concerns are important issues, and there is a need to reduce the amount of heavy rare-earth metals in Nd-Fe-B sintered magnets and develop alternative materials. Therefore, the IEEJ Technical Committee on Research and Development Trends and Applications of Next Generation Permanent Magnets (from April 2019 to March 2022) has investigated and elucidated the development trends of heavy rare-earth metal-reduction technologies and new magnet materials, and the current status of evaluation and analysis technologies, electronics and computer science, and application fields. Based on its past research activities, this committee investigates the development trends of technologies for the further reduction of heavy rare-earth metal usage, evaluation and analysis technology for permanent magnets, electronic theory and data science, material creation process technologies, and innovative magnet materials. We also investigate the development and supply trends of rare earth resources, magnet recycling technologies, and trends in applied fields. Through these activities, we propose the establishment of this committee for comprehensively ascertaining the trends in the development and application of high-performance permanent magnets toward carbon neutrality.

2. Background and internal and external research activities

Large-scale projects on permanent magnet materials have previously been conducted to clarify the optimum crystal structure and magnetization reversal process for high heat resistance. The material fabrication technology has been advanced by these studies, and free and low-Dy magnets are now being used in the drive motors of electric and hybrid vehicles. In addition, there has been remarkable progress in research on reducing the use of rare-earth metals and in the search for new magnetic compounds and their magnetic properties by materials informatics.

Through these studies, innovative magnet materials that can replace Nd-Fe-B sintered magnets have been actively explored. In the field of applied research on motors and generators, new applications are expanding, such as the electrification of aircraft and the spread of large-scale wind power generation. The loss reduction of high-speed motors and the improvement of efficiency by the variable magnetic force method have been proposed, and the realization of high-performance magnets is expected to further expand their applications to new fields, such as aircraft design.

3. Investigative matters

In view of the above, the Technical Committee on Research, which we propose to establish, will investigate the following matters:

1) Development trends of technologies to reduce the content of heavy rare-earth metals in high coercivity Nd-Fe-B sintered magnets
2) Trends in the development of material creation process technologies for high-performance bonded magnets and Sm-Fe-N sintered magnets
3) Development trends of innovative magnet materials other than Nd-Fe-B
4) Evaluation and analysis techniques for permanent magnets and R&D trends in electronics theory, data science, etc.
5) Development and supply trends of rare earth resources and R&D trends in magnet recycling technology
6) Necessary performance of magnets in the applied fields of permanent magnet motors, and research and development trends in motor efficiency improvement technology

4. Expected effects

1) Provision of information on high coercivity Nd-Fe-B magnets with reduced heavy rare-earth content technology
2) Provision of information on magnet materials developed by new material creation process technologies
3) Clarification of issues faced in the development of innovative magnet materials and provision of information on developed magnet materials
4) Provision of information on evaluation and analysis techniques for permanent magnets, electronics theory, data science, etc.
5) Provision of information on rare earth resources and magnet recycling technology
6) Understanding R&D trends of permanent magnet motors and in other application fields, and the outlook for future application trends

5. Term of investigation

April 2022 to March 2025 (3 years)

6. Committee members

Position	Name	Affiliation	Member/Non-member category of IEEJ
Chairperson	Masaaki Takezawa	Kyushu Institute of Technology	Member
Member	Toyonori Ariizumi	Toei Industry Co., Ltd.	Member
	Nobuyuki Inoue	Inoue Giken Co., Ltd.	Member
〃	Tadakatsu Okubo	National Institute for Materials Science	Non-member
〃	Satoshi Okamoto	Tohoku University	Member
〃	Kazuhiro Ogawa	Nissan Motor Co., Ltd.	Member
〃	Nobuhiro Katayama	Toda Kogyo Co.	Member
〃	Kurima Kobayashi	Shizuoka Institute of Science and Technology	Member
〃	Tetsuji Saito	Chiba Institute of Technology	Member
〃	Shinya Sakurada	Toshiba Corporation	Member
〃	Nobuo Sasaki	Tamakawa Co., Ltd.	Member
〃	Munekatsu Shimada	He used to work for Hirosaki University.	Member
〃	Satoshi Sugimoto	Tohoku University	Member
〃	Kenichiro Suwa	TDK Corporation	Member
〃	Kenta Takagi	National Institute of Advanced Industrial Science and Technology	Member
〃	Tomohiro Tanaka	Fujitsu, Ltd.	Non-member
〃	Sigeho Tanigawa	He used to work for Technology Research Association of Magnetic Materials for High-Efficiency Motors.	Member
〃	Masaaki Tokunaga	He used to work for Hitachi Metals, Ltd., and Meiji University	Member
〃	Masaki Nakano	Nagasaki University	Member
〃	Hajime Nakamura	Shin-Etsu Chemical Co., Ltd.	Non-member
〃	Takeshi Nishiuchi	Hitachi Metals, Ltd.	Member
〃	Hiroaki Nisio	Research Institute for Measurement of Magnetic Materials	Member
〃	Takashi Hasegawa	Akita University	Member
〃	Akio Hasebe	Musashi Energy Solutions Co., Ltd.	Member
〃	Satoshi Hirosawa	National Institute for Materials Science	Member
〃	Masakatsu Fukuda	He used to work for Mitsubishi Steel Mfg. Co., Ltd.	Member
〃	Hirotoshi Fukunaga	Nagasaki University	Member
〃	Michitaka Hori	Nihon Denji Sokki Co., Ltd.	Member
〃	Kenichi Machida	Osaka University	Member

Position	Name	Affiliation	Member/Non-member category of IEEJ
Member	Hiroaki Machida	Tokin Corporation	Non-member
〃	Masashi Matsuura	Tohoku University	Member
〃	Hideki Matsuda	Sumiko Kunitomi Denshi Co., Ltd.	Non-member
〃	Chisato Mishima	Aichi Steel Corporation	Member
〃	Hideto Yanagihara	University of Tsukuba	Non-member
〃	Osamu Yamada	MinebeaMitsumi Inc.	Member
〃	Hitoshi Yamamoto	KRI, Inc.	Member
Secretary	Hayato Hashino	Daido Electronics Co., Ltd.	Member
〃	Gaku Obara	Meiji University	Member

7. Activity schedule

Committee meetings: 4 times/year; Secretariat: 2 times/year;

Cooperative Technical Meetings: 2 times/year

8. Reporting format

A technical report shall be prepared to present the results.