Investigating R&D Committee on Magnetic Application Technologies for Energy Conversion Systems for Carbon Neutrality

Technical Committee on Magnetics

1. Objective

High-efficiency, low-loss, high-function energy conversion equipment and energy conversion systems based on magnetism are considered important among key technologies to realize the essential human goal of carbon neutrality. The objective of this committee is to conduct a comprehensive investigation of the present state and trends in magnetic application technologies for energy conversion systems, including electric drive systems and power sources based on diverse and flexible viewpoints, including machine design techniques, circuit technology, control technology, analytical techniques and magnetic sensing technology, and summarize beneficial information on magnetic application technologies to realize carbon neutrality.

2. Background and internal and external research activities

High-efficiency, low-loss, high-frequency, and miniaturization in magnetic devices are challenges to realize carbon neutrality in electric drive systems for electric cars and aircraft, power-generating systems involving wind power, other forms of renewable energy and energy harvesting and energy conversion systems such as power supplies, combining power electronics and power magnetics. In addition, advances are being made in the diversification of energy conversion systems, such as energy harvesting and wireless power transfer.

Hence, it is necessary to investigate the present state and trends in the technological issues facing high-efficiency, high-frequency, high density and high-function in magnetic devices from diverse viewpoints, including electrical-mechanical energy conversion, power conversion using power semiconductors, power control, magnetic materials and magnetic sensing, to further enhance magnetic application technologies to realize carbon neutrality.

3. Investigative matters

This committee shall research and investigate the following items related to identifying issues experienced by magnetic application technologies in energy conversion systems for carbon neutrality and how to solve them.

(1) Present state and trends in high-efficiency, low-loss, high-density technologies for energy conversion equipment such as motors, generators, and magnetic gears, and their practical application
(2) Present state and trends in high-efficiency, low-loss, and high-frequency technologies for magnetic devices in power electronics equipment, and their practical application
(3) Present state and trends in diversifying energy conversion systems, including wireless power transfer and energy harvesting
(4) Present state and trends in electromagnetic field analysis technology, circuit analysis technology, and magnetic sensing technology related to the aforementioned energy conversion systems

4. Expected effects

Identifying the various issues experienced by magnetic application technologies in energy conversion equipment and energy conversion systems for carbon neutrality, and compiling case examples of solutions to those issues for widespread dissemination, is expected to contribute to the further development of

energy conversion magnetic application technologies for carbon neutrality. In addition, this activity is mainly related to the industrial application of power electronics, and researching and investigating case examples of solutions to those issues spanning this specific field and magnetic applications, it may cont ribute to the development of both fields and help realize carbon neutrality.

5. Term of investigation

October 2021 to September 2024 (3 years)

6. Committee members

Position	Name	Affiliation	Member/Non-member category of IEEJ
Chairperson	Tatsuya Doi	Ashikaga University	Member
Member	Manabu Ishitobi	National Institute of Technology (KOSEN), Nara College	Member
〃	Toshiyuki Ueno	Kanazawa University	Member
〃	Kazuhiro Umetani	Okayama University	Member
〃	Hiroshi Unno	Shindengen Electric Manufacturing Co., Ltd.	Member
〃	Hisashi Endo	Hitachi Industrial Products, Ltd.	Member
〃	Yoshifumi Okamoto	Hosei University	Member
〃	Mamoru Kimura	Hitachi Metals, Ltd. / Shimane University	Member
〃	Naoyuki Kurita	Hitachi, Ltd.	Member
〃	Hiroki Goto	Utsunomiya University	Member
〃	Hideo Saotome	Chiba University	Member
〃	Yoshinori Sakamoto	Hachinohe Institute of Technology	Member
〃	Teruyoshi Sasayama	Kyushu University	Member
〃	Kengo Sugahara	Kindai University	Member
〃	Atsushi Takahashi	National Institute of Technology, Tsuruoka College	Member
〃	Kazuhiko Takahashi	Mitsubishi Power, Ltd.	Member
〃	Katsubumi Tajima	Akita University	Member
〃	Yoshihiro Nagasawa	National Institute of Technology, Akita College	Member
〃	Tadahiro Nakayama	Toshiba Corporation	Member
〃	Koji Nishi	Ashikaga University	Member
〃	Katsuhiro Fukuoka	Osaka Sangyo University	Member
〃	Koji Fujiwara	Doshisha University	Member
〃	Tatsuya Hosotani	Murata Manufacturing Co., Ltd.	Member
〃	Kenji Miura	Iwate University	Member
〃	Tsutomu Mizuno	Shinshu University	Member
〃	Hiroshi Yamada	National Institute of Technology,Sendai College	Non-member
Secretary	Kenji Nakamura	Tohoku University	Member
〃	Yukihiro Yoshida	Akita University	Member

7. Activity schedule

Committee meetings: 5 times/year; Secretariat: 2 times/year

8. Reporting format

Results will be reported in the form of a special issue of the transactions of Society A.

Reasons reporting in the form of a special issue of the transactions of Society A instead of a technical report are,

“Publishing the content of activities in a special issue of the transactions of Society A, which consists of reviews, briefings and original papers, will allow the publicizing of the investigative content comprising the

latest data in a timely manner. The research and investigative content are closely related to industrial applications and are expected to attract the interest of the Fundamentals and Materials Society the Industry Applications Society, and the members of other societies related to energy, which may increase the sales of transactions.”