

# **Investigating R&D Committee on Challenging Magnetic Technologies for Next-Generation Healthcare**

Technical Committee on Magnetics

## **1. Objective**

According to forecasts for 2040, the population of Japan will fall below 110 million, resulting in a rapid decrease in the productive population, while the elderly population peaks with the aging of baby boomers. If this situation persists, demand for medical and nursing care will increase rapidly in urban areas where population is concentrated, but there will be a shortage of those providing it. There will be concerns about risks, such as inability to receive sufficient medical and welfare services owing to accelerated population decline and aging in rural areas. A proposed countermeasure is to construct innovative healthcare and medical equipment fused with enhanced IoT, AI, big data, and robot technology, while building the social infrastructure to take advantage of them. The successive predictions for 2040, which have been reported in recent years, depict a society in which implantable connectors and wearable tech constantly monitor individual vital signs, and health management and medical systems have spread in which patients receive AI-guided diagnostic support online.

Healthcare and medical equipment using magnetism is highly attractive for its low invasiveness and is expected to play a major role in future healthcare. However, to respond to rapid changes in social structure and aforementioned ICT fields, it is essential to discover challenging technologies based on bold concepts and not merely extend conventional technologies. Implantable connectors and wearable tech that require magnetic field sensors, MEMS/NEMS devices, and man-machine interfaces, are becoming smaller and more sophisticated, and to realize them, we require broad research encompassing related technologies as well as research into underlying energy/signal transmission technologies, explanation of cerebral functions, and the effects of magnetic fields on living organisms.

As a result, the objective of this investigation committee is to conceive of next-generation applications to healthcare and medical devices, which may be realized in 2040, and broadly investigate challenging technologies, involving magnetic applications with related technologies.

## **2. Background and internal and external research activities**

General investigative activity by the IEEJ on biomagnetism has been conducted by previous investigation committees under the Technical Committee on Magnetics. These include the Investigation Committee on Seed Technologies for Medicine and Medical Applications using Magnetic Applications (Chairman Yamada), which has been active since 2009, and the Investigation Committee for the Creation of New Diagnostic and Medical Equipment using Magnetism, which has been active since 2012. These committees have explored a wide range of seed technologies, and have examined medical needs to discuss the possibility of creating new diagnostic and medical equipment. Furthermore, since 2018, the Investigation Committee on Researching Industry-Academia-Government Cooperation in Applications of Magnetic Fields and Magnetic Materials in Biotechnology and Medicine (Chairman of Sekino) has investigated how to pursue industry-academia-government cooperation, including responses and business strategies for regulations specific to biotechnology and medical devices, as well as examples thereof. A symposium was held at the IEEJ National Convention in 2021, concluding more than 10 years of research activity starting with the investigation into seed technologies.

The investigation activities of the new committee will be conducted from a mid-to-long-term perspective with an eye

toward the next generation of healthcare and medical devices based on IoT, AI, big data, and robotics technology, while encompassing the basic investigation considered by previous investigation committees. The committee's activities are preceded by the Investigation Committee on the Use of Magnetic Sensors and Machine Learning (Chairman Tashiro), which also deals with similar technical innovations in the ICT field. In addition, related activities are being carried out by investigation committees related to healthcare and medical devices, which have been established under the Technical Committee on Biotechnology and Microsystems of the Sensor Micromachine Society. The new committee aims to discover breakthrough ideas and innovative technological seeds through interdisciplinary discussions in cooperation with these investigation specialist committees.

### 3. Investigative matters

- (1) Investigation of trends in magnetic application technologies in biosensing and discovery of technological seeds
- (2) Research trends in magnetic application technologies in energy and signal transmission for implantable connectors and wearable tech
- (3) Research biomedical applications of magnetic actuators and MEMS/NEMS technologies and discovery of technological seeds
- (4) Research trends related to physiological responses to magnetism and discover technology seeds
- (5) Research trends in guidelines for magnetic use in healthcare and medical equipment

### 4. Expected effects

It is felt that searching for and identifying challenging and innovative technological aspects using magnetic applications for healthcare and medicine will help develop next-generation healthcare and medical equipment and eventually help develop healthcare and medical equipment industry in Japan, individualized prevention, and improved QOL.

### 5. Term of investigation

October 2021 to September 2024 (3 years)

### 6. Committee members

Position	Name	Affiliation	Member/Non-member category of IEEJ
Chairperson	Takashi Honda	Kyushu Institute of Technology	Member
Member	Masateru Ikehata	Railway Technical Research Institute	Member
"	Kazushi Ishiyama	Tohoku University	Member
"	Takahiro Ito	Kyushu Institute of Technology	Non-member
"	Keiji Iramina	Kyushu University	Non-member
"	Masakazu Iwasaka	Hiroshima University	Member
"	Gen Uehara	Kanazawa Institute of Technology	Member
"	Tsuyoshi Uchiyama	Nagoya University	Member
"	Satoshi Ota	Shizuoka University	Member
"	Masato Odagaki	Maebashi Institute of Technology	Member
"	Koichiro Kobayashi	Iwate University	Member
"	Tadahiko Shinshi	Tokyo Institute of Technology	Member
"	Nobuo Suzuki	Kanazawa University	Non-member
"	Masaki Sekino	The University of Tokyo	Member
"	Yasushi Takemura	Yokohama National University	Member

<b>Position</b>	<b>Name</b>	<b>Affiliation</b>	<b>Member/Non-member category of IEEJ</b>
Member	Kunihisa Tashiro	Shinshu University	Member
"	Satoshi Nakasono	Central Research Institute of Electric Power Industry	Member
"	Shin Yabukami	Tohoku University	Member
"	Sachiko Yamaguchi	National Institute of Occupational Safety and Health, Japan.	Member
"	Takao Yamaguchi	Ishida Ironwork's Co., Ltd.	Member
"	Takashi Yoshida	Kyushu University	Member
"	Masaya Watada	Tokyo City University	Member
Secretary	Makiko Kakikawa	Kanazawa University	Member
"	Fumihiro Sato	Tohoku Gakuin University	Member

### **7. Activity schedule**

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

### **8. Reporting format**

The results of research are scheduled to be summarized in a special issue of the transactions of Society A. Reason for a special issue of the transactions of Society A instead of a technical report: This research aims to challenge seed technologies originating in academia. As the percentage of research-oriented committee members and organizations is high, switching to a special issue of the transactions of Society A from a technical report may attract researchers from other societies of the IEEJ and non-IEEJ members as readers or authors, which is expected to contribute to Society A in the form of new members, submission fees, and sales.