Updates of HTS Large Scale Application Projects in Japan

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HTS Large Scale Application Projects in Japan

- **NEDO**
  - ✓ **NEDO Feasibility Study Program**
  - ✓ **NEDO Program for Advanced Aircraft Systems for Practical Application**
- **Railway Application**
  - ✓ **Superconducting Cable**
  - ✓ **Flywheel Energy Storage System**
- **JST**
  - ✓ **JST-Mirai Program**

NEDO: New Energy and Industrial Technology Development Organization

JST: Japan Science and Technology Agency

NEDO Feasibility Study Program

- Purpose

  Development of superconductivity-related technology using hydrogen cold heat for the construction of a hydrogen society to realize carbon neutrality in 2050.

- Projects (R&D)

Title (provisional)	Period	Members
Liquid hydrogen-cooled high-temperature superconducting generator	2022FY -2023FY	Mitsubishi Electric Corp. Kansei Gakuin Univ. Univ. of Tokyo Kyoto Univ. Japan Aerospace Exploration Agency (JAXA)
Ultra-fine MgB2 superconducting wire	2022FY	National Institute for Material Science Meiko Futaba Corp.

In charge of Energy Conservation Technology Dept.

NEDO Program for Advanced Aircraft Systems for Practical Application

https://www.nedo.go.jp/english/activities/activities_ZZJP_100104.html

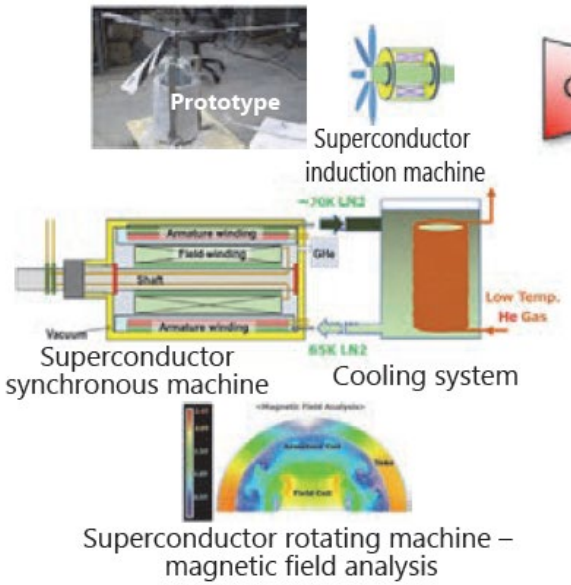
Practical application project for aircraft advanced system

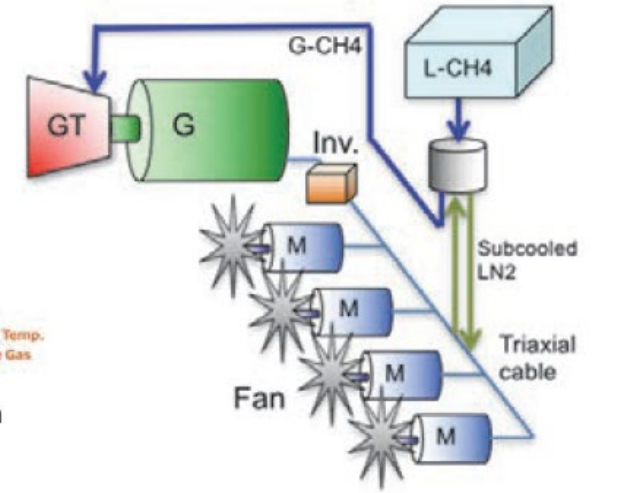
R&D for next-generation electrical propulsion system

High efficiency and high power electric propulsion system

To evaluate propulsion systems using superconducting technology with high efficiency and high power density for electric aircraft to achieve TRL6.

(FY2019 – FY2023)





Power and coolant flow in the electric engine system

R&D Team:

Kyushu Univ.,
AIST,
Taiyo Nippon Sanso Corp.,
SuperOX Japan,
SWCC SHOWA CABLE SYSTEMS CO.,LTD.

Source: NEDO Projects in the Robotics and Artificial Intelligence Fields, November 2020

NEDO Practical application project for aircraft advanced system/ R&D for next-generation electrical propulsion system/ High efficiency and high power electric propulsion system

Kyushu Univ., AIST, Taiyo Nippon Sanso Corp., SuperOX Japan, SWCC SHOWA CABLE SYSTEMS CO.,LTD. (FY2019 – FY2023)

- Development of elemental technologies for superconducting propulsion systems for aircraft

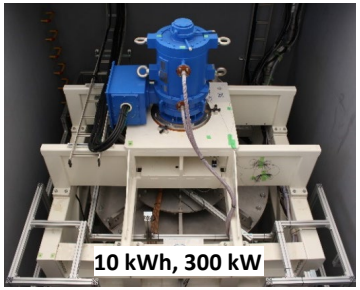
Fundamental Technology Development Items	R&D Targets
Superconducting rotating machines	Clarification of challenges and solutions for superconducting rotating machines for development of 20 MW systems
Superconducting cables	Clarification of challenges and solutions for superconducting cables and their related technologies for development of 20 MW systems
Cooling systems	Clarification of challenges and solutions in cooling system for development of 20 MW systems
Superconducting wires	・10 filaments, 100 m, 300 A/cm@70K, 1.2T. Yield ＞ 60% ・>500 A/cm @70 K, 2.5 T, 100 m ・Establish magnetic shielding technology for 20 MW systems
Semiconductor devices operating at cryogenic temperatures	Development of semiconductor devices operating at 65 K

- Verification of equipment functionality of superconducting propulsion systems for aircraft
  - ➢ Verification of 500 kW-class superconducting motor
    - ✓ Evaluate the feasibility of installing a 250-500 kW motor on an actual aircraft by conducting ground tests corresponding to flight conditions.
  - ➢ Verification of 1 MW-class superconducting propulsion system
    - ✓ Verify the feasibility of the superconducting propulsion system by fabricating a 0.5-1 MW superconducting propulsion system and performing basic evaluations.

Railway Application

NEDO supported the R&D projects of the following equipment for railway application.

- ✓**Flywheel Energy Storage**
- ✓**Superconducting DC Cable**



Railway Technical Research Institute

Recent progress

- **JR East: Development of superconducting flywheel energy storage**
  https://www.jreast.co.jp/e/development/theme/energy/energy02.html
  https://www.jreast.co.jp/E/development/tech/pdf_38/tec-38-55-58eng.pdf
- **JR East Press Release: Demonstration test of superconducting flywheel energy storage system for railway begins** (June 7, 2022) (*in Japanese*)
  https://www.jreast.co.jp/press/2022/20220607_ho01.pdf
- **A superconducting cable and a superconducting flywheel energy storage system are mentioned in JR East Group Report "INTEGRATED REPORT 2020" and in JR East's long-term environmental goal "Zero Carbon Challenge 2050."**
  https://www.jreast.co.jp/e/environment/pdf_2020/all.pdf
  https://www.jreast.co.jp/press/2020/20200512_ho02.pdf
- **Railway Technical Research Institute:** https://www.rtri.or.jp/eng/

JR East: East Japan Railway Company

JST-Mirai Program

https://www.jst.go.jp/mirai/en/

Large-scale Type

https://www.jst.go.jp/mirai/en/program/large-scale-type/theme02.html

High-temperature superconducting wire joint technologies leading to innovative reduction of energy loss

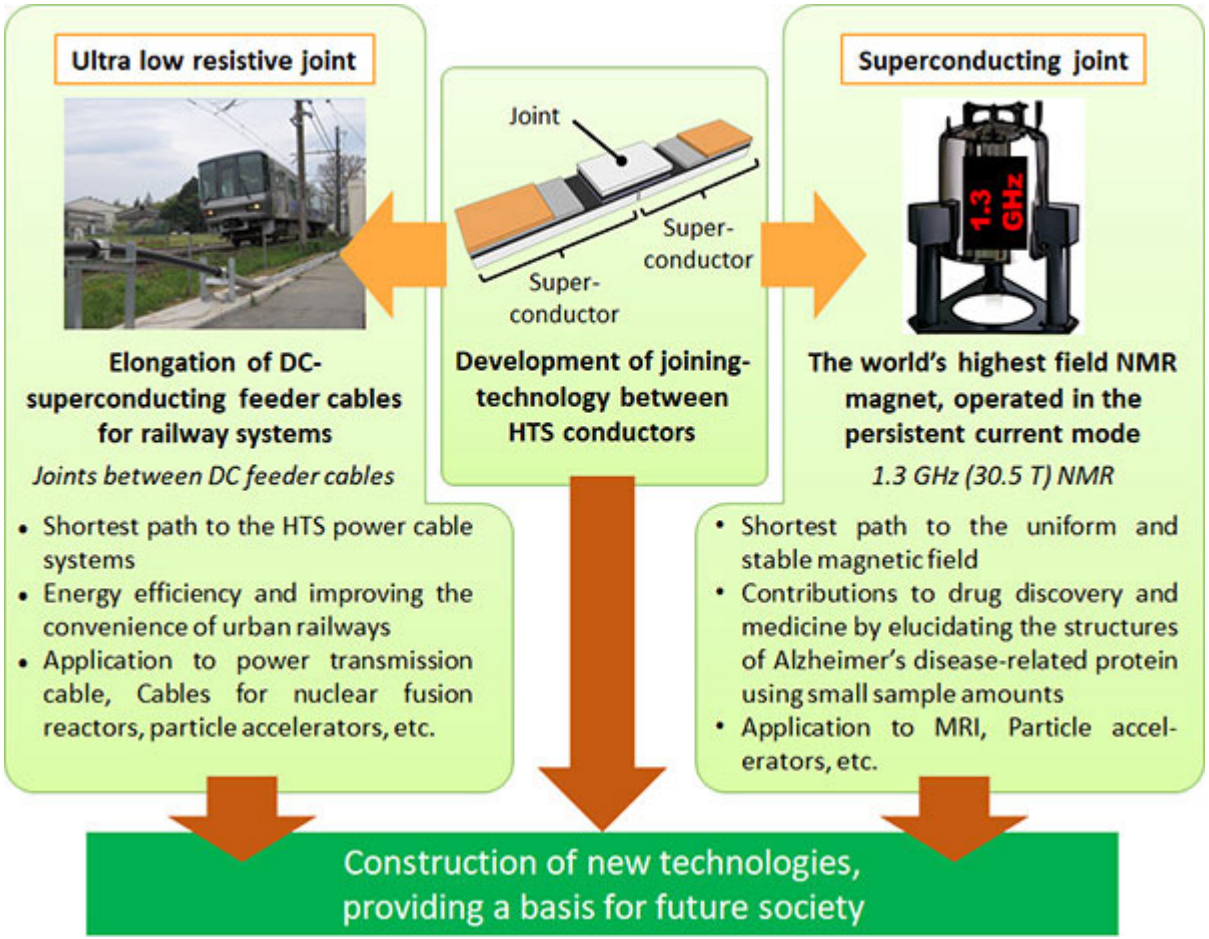
Social implementation of super-high field NMRs and DC superconducting cables for railway systems, through advancement of joint-technology between high temperature superconducting wires

Program Manager:
Dr. MAEDA Hideaki

R&D Period:
from Nov. 2017

R&D Team:
RIKEN, Aoyama-Gakuin University, National Institute for Materials Science, TEP, Sumitomo Electric, Japan Fine Ceramics Center, Kyushu University, Japan Superconductor Technology, Okayama University, Tokyo Institute of Technology, JEOL RESONANCE, Railway Technical Research Institute, Kyushu Institute of Technology, Tohoku University, Muroran Institute of Technology

https://www.jst-mirai-sc.riken.jp



JST-Mirai Program

https://www.jst.go.jp/mirai/en/

Area: "**Low Carbon Society**" mission area

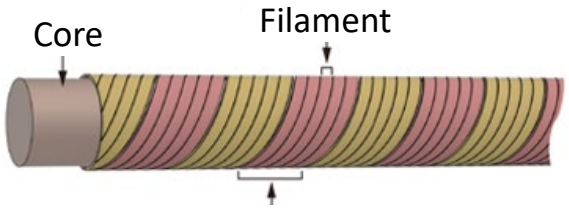
Projects related to superconducting technology

https://www.jst.go.jp/mirai/en/program/lowcarbon/theme01.html

- **Superconducting Computing for Low Carbon AI** (2018 -)
  Project leader: INOUE Koji（*Professor, Department of I&E Visionaries, Kyushu University*）
  https://www.jst.go.jp/mirai/en/uploads/saitaku2018/JPMJMI18E1_inoue_en.pdf

- **Low-AC-Loss and Robust High-Temperature-Superconductor Technology** (2019 -)
  Project leader: AMEMIYA Naoyuki（*Professor, Department of Electrical Engineering, Kyoto University*）https://www.jst.go.jp/mirai/en/uploads/saitaku2019/JPMJMI19E1_amemiya_en.pdf

SCSC cable (Spiral Copper-plated Striated Coated-conductor cable)
Press release: AC loss of high-temperature superconducting wires reduced to 1/20 (Nov. 16, 2021)



Multi-filament REBCO wire


photo

https://www.kyoto-u.ac.jp/ja/research-news/2021-11-16-0
https://www.furukawa.co.jp/release/2021/kenkai_20211116.html