Project Name: International Joint Research on High Voltage Devices and Power Electronics Element Technologies for the Effective Utilization of Renewable Energy

(2020–2023*)

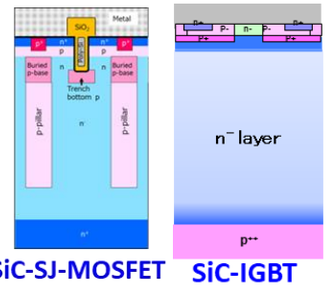
*scheduled

Entrusted parties: National Institute of Advanced Industrial Science and Technology (AIST)
Central Research Institute of Electric Power Industry (CRIEPI)

Outline of the project

For the introduction and effective use of clean energy, it is necessary to have high-efficiency and low-cost power electronics equipment that adjusts the power system network and optimizes the balance between supply and demand. In this international joint research project, in order to realize this kind of power electronics equipment, we will conduct fundamental and basic research on process technologies for cost reduction of high- and ultra-high voltage SiC (silicon carbide) power devices with ETH Zurich, Kyoto univ. Tsukuba univ. and NITech.

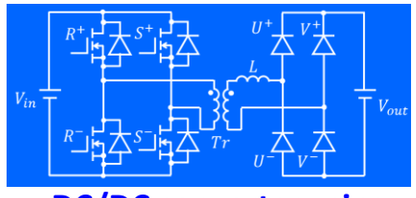
A. Establishment of innovative Superjunction (SJ) structure formation technology using ultra-high energy ion implantation.
B. Dramatic improvement of the uniformity and yield of ultra-high voltage bipolar devices by neutron doping technology.



SiC-SJ-MOSFET SiC-IGBT

In collaboration with Virginia Tech (CPES), NITech and Tsukuba Univ.,

C. Joint prototyping and evaluation of high-voltage modules using high voltage SiC-MOSFETs will be conducted. Through prototyping isolated high voltage DC/DC converters, and the like, issues for power control equipment applications will be clarified.



DC/DC converter using high voltage modules

Significance of international R&D

Both the ultra-high energy (>10 MeV) ion implantation facility and the neutron irradiation facility are not currently available in Japan. This study can only be validated in cooperation with Europe.

Virginia Tech. (CPES) of the U.S. is a leader in high-voltage SiC module technology. By collaborating with Japan, which has high- and ultra-high-voltage SiC device and power electronics technologies, we will be able to evaluate high-voltage power electronics technology for the first time. As a result, this project is expected to contribute to the promotion of domestic industries dealing with future power systems.

Project scheme

NEDO

Funding

AIST
CRIEPI
subcontract
Kyoto University,
NITech,
Tsukuba
University

Joint R&D contract

ETH Zurich (Switzerland), mi2-factory (Germany), Virginia Tech. (Center for Power Electronics, CPES) (US)

Expected outcomes

The market size for power systems in the power electronics market is estimated to grow from its current level of around 900 billion yen to more than 2 trillion yen after 2030. If all high-voltage (6.6 kV/200 V) transformers were replaced with SSTs (Solid State Transformers), the number of units of 6.6 kV 100 kVA SSTs per unit would be 3,693,000. Assuming a 30-years service life for SSTs, annual demand is expected to be 123,100 units. The energy-saving effect of this is expected to be 135,000 kL/year (in 2030) in crude oil equivalent.