

第4回電気系科学技術談話会
The Fourth EE Forum on Science and Technology



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講演テーマ：大電力用パワーエレクトロニクスの最前線
Title : The Cutting Edge of Power Electronics for High-Power Applications

日時：2014年7月23日(水) 17:30-18:30
場所：H101
Date and time: 17:30-18:30, July 23(Wed), 2014
Conference Room: H101

講演要旨：

パワーエレクトロニクスは、MOSFET, IGBTなどのパワー（半導体）デバイスのスイッチング（オン・オフ）動作をベースにした電力変換システムとその応用を対象とした技術分野である。現在では、情報機器・家電から一般産業、交通（自動車、鉄道、船舶、飛行機）、電力・エネルギー分野に至る電子・電気・電力機器に幅広く活用されている。

1957年に米国GE (General Electric) 社の研究者がサイリスタを発明し、「パワーエレクトロニクス」という技術分野が誕生した。当時「パワーエレクトロニクス」という用語は使用されることはなく、1970年代になってから電気電子工学分野で「パワーエレクトロニクス」という用語が定着した。事実、1978年にはパワーエレクトロニクスのノーベル賞と称されるIEEE William E. Newell Power Electronics Awardが創設された。

本講演では、パワーエレクトロニクスの研究最前線を紹介する。具体的には、高圧大容量蓄電池システム、高圧大容量交流モータ駆動システム、最新の1.2-kV, 400-A SiC-MOSFET/SBDモジュールを使用した750-Vdc, 100-kW DC-DCコンバータについて説明する。高圧大容量電力変換システムは、価格よりも性能・信頼性・寿命などが重視されるので、日本企業の優位は揺るがない。ただし、油断は禁物である。

最後に、「1980年前後にIEEE Transactions on Industry Applicationsに掲載された、Citation Indexが2000の論文とCitation Indexが1の論文とでは何が違うか」という、博士学生を含む若手研究者が抱く素朴な疑問について、講演者の経験に基づいた回答を披露したい。

Abstract:

Power electronics is the technical field that includes power conversion systems based on switching, or on/off, operation of power semiconductor devices such as MOSFETs and IGBTs (insulated-gate bipolar transistors), and applications of the power conversion systems. At present, power electronics technology is applied to a broad range of fields from information and home appliances to industry, transportation (vehicles, ships and airplanes), and electric power utilities, as well as renewable-energy harvesting.

Power electronics emerged in 1957, accompanied by the invention of the so-called “silicon-controlled rectifiers” or “thyristors” by research scientists in General Electric in the USA. However, the term “power electronics” did not exist at that time. Since the 1970s, it has been used, and it is currently a firm technical term in electrical and electronic engineering. In fact, the IEEE William E. Newell Power Electronics Award was established in 1978. Since then, it has been recognized as the “Noble Prize” in the field of power electronics amongst its related research scientists and engineers.

The speaker will talk about the cutting edge of power electronics intended for high-power applications in terms of research. This talk focuses mainly on medium-voltage high-power battery energy storage, and ac motor drive systems, as well as a 750-Vdc, 100-kW DC-DC converter using the latest 1.2-kV, 400-A SiC-MOSFET/SBD dual modules. The Japanese power electronics industry leads and will lead the worldwide market, competing with the European industry, because the performance, reliability, and lifetime of a power electronics product are more important in high-power applications than its price. However, the Japanese industry and academia will have to make continuous efforts toward technological innovation.

Finally, this speaker will provide an answer, based on his experiences, to the following simple question asked by young research scientists including Ph. D. students: “What is a difference between a paper with a citation index of more than 2000 times and another paper with that of 1 time, both of which were published in the IEEE Transactions on Industry Applications around 1980?”