Summary of the 2nd Workshop

University of Tsukuba Forum on Power Electronics Tomorrow (UTOP)

"SiC Power Devices for Extended Applications"

Time & Date: 1:30-5:35pm, December 5, 2014

Venue: Bunkyo School Building, Tokyo Campus, University of Tsukuba

Program:

Mediator: Yuji Yano, Associate Professor, Institute of Applied Physics, University of Tsukuba

13:30 Opening Remarks
Noriyuki Iwamuro, Professor, Institute of Applied Physics, University of Tsukuba

13:35 "How far we know about point-defect in 4H-SiC?" - Crystal and MOS interface -
Takahide Umeda, Associate Professor, Institute of Applied Physics, University of Tsukuba

14:25 "NEDO's program for achieving energy conserving society"
Koki Yamamoto, Project Manager, New Energy and Industrial Technology Development Organization (NEDO)

14:55 - 15:10 Coffee break

Mediator: Takonori Isobe, Associate Professor, Institute of Applied Physics, University of Tsukuba

15:10 "Power electronics technologies for hybrid vehicles and application of SiC "
Kimimori Hamada, Director, Electronics Development, Toyota Motor Corp.

16:00 "Power electronics in power systems and local power sources"
Noriko Kawakami, Chief Engineer, Toshiba Mitsubishi-Electric Industrial Systems Corp. (TMEIC)

17:00 Panel Discussion "Aiming for SiC Power Devices with Greater Availability"

Mediator: Prof. Hiroshi Tadano, Institute of Applied Physics, University of Tsukuba

Panelists: Prof. Takahide Umeda, University of Tsukuba
Mr. Koki Yamamoto, NEDO
Mr. Kimimori Hamada, Toyota Motor Corp.
Dr. T Noriko Kawakami, TMEIC

17:35 Closing Address

1. How far we know about point-defect in 4H-SiC?" - Crystal and MOS interface -
   Takahide Umeda, Associate Professor, Institute of Applied Physics, University of Tsukuba

Defect control of SiC crystals are very important to improve device performances. Crystal defects include dislocation and point-defect, both are important factors from the standpoint of device performance.
Concerning the point-defects in the bulk crystal, most of their features are understood by Electron Spin Resonance (ESR) analysis and First-principles Calculation. On the other hand, defects in MOS are still not clear by now.
Examples of defect identification by ESR method were presented. Electrically Detected Magnetic. Resonance (EDMR) method was explained for analyzing MOS interface.

2. NEDO's program for achieving energy conserving society
   Koki Yamamoto, Project Manager, New Energy and Industrial Technology Development Organization (NEDO)

NEDO's programs, especially for development on Power Electronics Substrates were presented.
NEDO expects technological and industrial progress in the field of power electronics in order to extend environment-friendly and energy-conserving society.
NEDO offers project application to the public in April through June and launches the projects in August.
NEDO will start "Clean device promotion project" in FY 2016. It defines "Clean device" as the latest devices very close to commercialization and expected large effects for energy conservation.

3. Power electronics technologies for hybrid vehicles and application of SiC
   Kimimori Hamada, Director, Electronics Development, Toyota Motor Corp.

   TOYOTA is looking at power grids with renewable energy sources and hydrogen grid; and conducting researches on diversification of power trains.

TOYOTA has sold over seven millions of hybrid vehicles in the world. Prius has been improved to 1/3 in system cost and 35% reduction in mileage comparing to the original model in 2003.
EV, HV, PHV and FCV will survive according to their vehicle sizes and cruising distances. The common technology among those vehicles is power electronics.
TOYOTA is developing SiC devices as important parts for the power control unit, aiming at reducing vehicle mileage by 10% by shifting Si modules to SiC modules.

4. Power electronics in power systems and local power sources
Noriko Kawakami, Chief Engineer, Toshiba Mitsubishi-Electric Industrial Systems Corp. (TMEIC)

TMEIC is producing rotary machinery and power electronics equipment for industry.
As power electronics equipment, it manufactures uninterruptible power-supply unit (UPS), motor-drive inverter, equipment for local power source, power grid and other industrial application.
TMEIC annually supplies over 3,000 units of UPS having capacity of 10kVA or more, and their capacities are getting larger.
GTO, GCT, IEGT and IGBT have been applied to motor-drive inverters as power chips. The latest IGBT, the 6th generation, has been improved to 1/3 in losses comparing to the original model of the 1st generation. Today, SiC device attracts much attention as a next-generation device, which would contribute to higher efficiency, downsizing and cost reduction of the equipment. Problems to be solved regarding SiC devices would be cost-reduction, quality-stability and steady supply systems.

5. Panel Discussion “Aiming for SiC Power Devices with Greater Availability”

Prof. Tadano had charge of moderator, Mr. Yamamoto of NEDO, Mr. Hamada of TOYOTA and Dr. Kawakami of TMEIC took part in the discussion as panelists. Panelists and attendants on the floor had a short but fruitful time for exchanging

views on SiC devices; What kinds of devices would be desirable? How important peripheral technologies could be?
Suggestions concerning patent strategy, easier procurement of sample devices, etc. were also addressed in the discussion.