1. SCIENTIFIC REPORT

The 77th IUVSTA workshop on "Surface Processes, Gas Dynamics, and Vacuum Technology of Cryogenic Vacuum Systems" was held at the Kasugai-View Hotel in Fuefuki city, Yamanashi prefecture, Japan, from August 17th to 21st, 2016. It was organized as a satellite conference of IVC-20, which was held in Busan, Korea, from August 21st to 26th, 2016. The workshop attracted 34 attendees, including 16 invited speakers, from 19 institutions in 8 countries.

In the various modern applications of vacuum technology, the presence of a low temperature surface in a vacuum system is very common. The behavior of such a system is often determined by physical processes at the cold surface. At this workshop, the physical basis of gas-surface processes at the cold surface and related phenomena were discussed. Specific topics of the workshop were:

1) Technological problems in cryogenic vacuum systems: cryopumps, cold-bore accelerators, and gravitational wave detectors;
2) Gas-surface dynamics in cryogenic vacuum systems: adsorption, desorption, accommodation coefficient, sticking probability, and mean residence time;
3) Desorption at cold surfaces: thermal desorption, and desorption induced by electronic transitions;
4) Electronic processes on cold surfaces: secondary electron yield, photo-electron yield, and discharge;
5) Physical and chemical processes on cold surfaces: dynamics induced by electronic transitions, and chemistry of interstellar particles.

In the first half of the workshop, specific case studies of vacuum systems in which cold surfaces play an important role were reported: the interferometer using cold mirrors of the
large-scale cryogenic gravitational-wave telescope (KAGRA), the superconducting RF cavities for the particle accelerators at KEK and CESR (Cornell), the cryopumping systems at LANSCE (Los Alamos), and the polarized electron source at JLAB. General aspects of cold vacuum systems (CERN), Monte Carlo simulations of non-isothermal vacuum systems, and gas dynamics modeling were also discussed. Cryopumps for special uses were reported on by the developer of ULVAC Cryogenics, Inc. In the second half, physical and chemical processes at cold surfaces were discussed: secondary electron yield, secondary photon stimulated desorption, and outgassing in accelerators and synchrotrons. More fundamental studies at well-defined surfaces were also presented: post-desorption from pre-irradiated solidified gases, electronic excitations followed by desorption in condensed rare gases, physical and chemical processes of interstellar dust grains, and the chemistry of a spontaneously electrical solid. These basic studies on various phenomena at cold surfaces that were introduced in the second half of the workshop were, of course, related to wider scientific fields, such as surface sciences, material sciences, astrophysics, and astrochemistry. At the same time, they are also closely related to the various phenomena in vacuum systems discussed in the first half of the workshop.

At the workshop, 14 posters were presented in the evening poster sessions of August 18th and 19th. Most of them were by colleagues of the invited speakers, and had direct relationships to the topics presented in the oral sessions. They generated lively and animated discussions, which took place in the coffee breaks afterwards, and even before oral presentations as well.

We now realize that there are a variety of unresolved problems concerning cold surfaces in vacuum, such as absorption and desorption of gas molecules, electronic excitations and induced dynamics in the adsorbed layer, the effect of the adsorbed layer on the electronic properties of a surface, and so on. The characteristics of a vacuum system are inevitably affected by these phenomena at cold surfaces. We should carry out extended research into the physics and chemistry at the cold surface in vacuum. In order to stimulate and to promote this research, we believe that discussions among delegates from both vacuum technology and fundamental science would be highly fruitful, as was shown at this workshop.

2. ORGANISATION

Chair
Ichiro Arakawa, Department of Physics, Gakushuin University, Tokyo

International Organizing Committee
Ichiro Arakawa, Department of Physics, Gakushuin University, Tokyo
Paolo Chiggiato, CERN, Geneva
Katsuyuki Fukutani, University of Tokyo, Tokyo
Joe Herbert, STFC, Daresbury

Local Organizing Committee
Ichiro Arakawa, Department of Physics, Gakushuin University, Tokyo
Katsuyuki Fukutani, University of Tokyo, Tokyo
Shinichiro Michizono, KEK, Tsukuba
Shohei Ogura, University of Tokyo, Tokyo
Masahiro Sasaki, University of Tsukuba, Tsukuba
3. NUMBER OF PARTICIPANTS
Invited Speakers: 16
Contributed Poster Presenters: 13
Auditors: 5 (including committee members)
Accompanying Persons: 6

4. SPONSORS
International Union for Vacuum Science, Technique and Applications (IUVSTA)
Vacuum Society of Japan (VSJ)
MIRAPRO
ULVAC
ULVAC Cryogenics
Agilent Technologies
Mitsubishi Heavy Industries Mechatronics Systems

5. PROGRAM
Oral presentations were given by 16 invited speakers, 50 min in length including discussion. Posters were presented by the other participants at the poster sessions at 19:30 - 21:00 on August 18th and 19th. All the posters were displayed in the rear corner of the meeting room during the workshop for discussion at any time.

Oral Presentations
S-1 Yoshio Saito
KAGRA Observatory, Institute for Cosmic Ray Research, University of Tokyo,
"KAGRA vacuum system of cryogenic interferometer"

S-2 Eiji Kako
KEK, High Energy Accelerator Research Organization
"Technologies in superconducting RF cavities for particle accelerators"

S-3 Yulin Li
Cornell Laboratory for Accelerator-based Sciences and Education
"Analysis of gas evolution and desorption from superconducting RF cavities in CESR and the implications to their long-term operational stability"

S-4 Tsuyoshi Tajima
Los Alamos National Laboratory
“Los Alamos Neutron Science Center (LANSCE) 800 MeV H+/H- accelerator vacuum system and the role of cryopumps”

S-5 Vincent Baglin
CERN
"CERN cryogenic beam vacuum systems : studies, design, operation and
upgrades"

S-6 Marton Ady
CERN
"Monte Carlo simulations of time-dependent and non-isothermal vacuum systems"

S-7 Christian Day
Institute for Technical Physics, Karlsruhe Institute of Technology (KIT)
"Cryogenic pumping - Technology development and gas dynamics modeling"

S-8 Shinji Furuya
ULVAC Cryogenics
"Cryopump - special specifications and applications"

S-9 Marcy L. Stutzman
Thomas Jefferson National Accelerator Facility
"Investigations of cryopumping in extreme high vacuum systems"

S-10 Mauro Taborelli
CERN
"Secondary electron yield measurements on cold surfaces"

S-11 Oleg B. Malyshev
ASTeC, STFC Daresbury Laboratory
"Discovery of secondary photon stimulated desorption and its implication to cryogenic vacuum systems design of particle accelerators"

S-12 Gao-Yu Hsiung
National Synchrotron Radiation Research Center
"Outgas and photon stimulated desorption in the synchrotron light source"

S-13 Ivan V. Khyzhniy
B. Verkin Institute for Low Temperature Physics and Engineering
"Super-strong low-temperature "post-desorption" from preirradiated solidified gases"

S-14 Takato Hirayama
Department of Physics, Rikkyo University
"Electronic excitations and decay processes in condensed rare gases studied by low-energy electron, photon, and ion impact"

S-15 Francois Dulieu
University of Cergy Pontoise - LERMA
"Physical and chemical processes at the surface of cold interstellar dust grains"

S-16 Jérôme Lasne
Laboratoire Interuniversitaire des Systèmes Atmosphériques
“Laboratory studies of spontaneously electrical solids: Astrophysical implications"

**Poster Presentations**

P-1 T. Suzuki, N. Kimura, T. Tomaru, Y. Saito
High Energy Accelerator Research Organization, KAGRA Laboratory
“Cryogenic system of KAGRA”
P-2 Tetsuro Nakamura, Yoshio Saito
MIRAPRO Co. Ltd.
“Production process of KAGRA beam tube and chambers”
P-3 Cédric Garion, M. Morrone
CERN
“Design of the HL-LHC beam screens with shielding operating at cryogenic temperature”
P-4 Y. Suetsugu, K. Shibata, T. Ishibashi, M. Shirai, S. Terui
High Energy Accelerator Research Organization (KEK)
“Electron cloud effect observed in the first stage of SuperKEKB commissioning”
P-5 Masahiro Yamamoto
High Energy Accelerator Research Organization (KEK)
“Effective pumping speed measurement of a cryopump under XHV using a standard conductance element”
P-6 Mitsuki Terashima
ULVAC CRYOGENICS INCORPORATED
“Cryopumps for Industry and Science Fields”
P-7 Marcel Lotz, Stefan Wilfert, Oliver Kester
GSI Helmholtz Center for Heavy Ion Research, Goethe University
“Investigation of a field emitter-based vacuum gauge for the operation in cryogenic vacuum systems”
P-8 Dmitry Ivanov, Satoshi Ohno, Katsuyuki Fukutani
Institute of Industrial Science, University of Tokyo
“Desorption of molecularly chemisorbed H2 on Pd surfaces”
P-9 Koichiro Yamakawa, Shinya Azami, Ichiro Arakawa
Department of Physics, Gakushuin University
“Nuclear spin conversion of H2O in solid Ar”
P-10 Yoichi Shimazaki, Koichiro Yamakawa, Ichiro Arakawa
Department of physics, Gakushuin University
“Infrared spectroscopy of CH4-D2O complex in Ar matrices as a preliminary step toward investigating the photochemical reaction of water-methane-ammonia clusters”
P-11 T. Tachibana, T. Yamashita, M. Nagira, H. Yabuki, L. Chiari, T. Hirayama, Y. Nagashima
Department of Physics, Rikkyo University
“Comparative study of electron- and positron-stimulated ion desorption from TiO2 (110) surface”
P-12 Matthieu Scannapiego, Christian Day, Xueli Luo
Institute for Technical Physics, Karlsruhe Institute of Technology
“Experimental and numerical investigation on charcoal adsorption surface”
sticking coefficients for cryogenic pump application”

P-13 Anne-Laure Lamure
CERN
“Adsorption/ desorption of gases from amorphous carbon coating at cryogenic temperature”

P-14 Ichiro Arakawa, Yuki Kato, Kohta Kawahara, Hayato Yamazaki,
Koichiro Yamakawa
Department of Physics, Gakushuin University
“Isotherm and mean residence time of hydrogen physisorbed on copper surface in submonolayer range”

6. COMMUNAL RECREATION

Welcome Reception: August 17, 19:00 - 21:00
Excursion (Winery Tour): August 18, 15:30 - 16:30, Mars Winery
Excursion (Bus Tour): August 19, 13:00 - 18:10, Fuji Lake District by bus
Banquett: August 20, 18:00 - 20:00, Budo-no-oka restaurant
### INCOME

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