

77th IUVSTA Workshop  
on  
Surface Processes, Gas Dynamics, and Vacuum Technology  
of Cryogenic Vacuum Systems

August 17 – 21, 2016, Fuefuki, Yamanashi, Japan

Organized by the Vacuum Science and Technology Division of IUVSTA

## Workshop Report

prepared by  
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### 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

Kyo Shibata, KEK, Tsukuba  
Yusuke Suetsugu, KEK, Tsukuba  
Yoichi Yamada, 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<sup>+</sup>/H<sup>-</sup> 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 H<sub>2</sub> on Pd surfaces”*
- P-9 Koichiro Yamakawa, Shinya Azami, Ichiro Arakawa  
Department of Physics, Gakushuin University  
*“Nuclear spin conversion of H<sub>2</sub>O in solid Ar”*
- P-10 Yoichi Shimazaki, Koichiro Yamakawa, Ichiro Arakawa  
Department of physics, Gakushuin University  
*“Infrared spectroscopy of CH<sub>4</sub>-D<sub>2</sub>O 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 TiO<sub>2</sub> (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

Budget for 77th IUVESTA Workshop (August 17-21, 2016, Fuefuki, Japan)

INCOME		Unit cost (JPY)	Quantity	Sub-total (JPY)
	Registration fee (contributed)	30 000	19	570 000
	Registration fee (accompanying)	20 000	4	80 000
	Accommodation fee (4 nights)	45 000	17	765 000
	Accommodation fee (3 nights)	34 000	4	136 000
	Accommodation fee (2 nights)	23 000	3	69 000
	Accommodation fee (1 night)	12 000	1	12 000
	IUVSTA funding (6,000 EUR)			684 480
	VSJ funding			103 927
	Total (JPY)			2 420 407

OUTGO		Unit cost (JPY)	Quantity	Sub-total (JPY)
	Meeting room	32 400	4	129 600
	Poster board rental			111 888
	Temporary labors (booklet)			20 400
	Hotel rooms	7 710	133	1 025 430
	Hotel rooms (child)	5 442	8	43 536
	Meals (breakfast)	1 080	125	135 000
	Meals (lunch)	864	104	89 856
	Meals (supper)	2 376	103	244 728
	Meals (breakfast, child)	756	8	6 048
	Meals (lunch, child)	605	6	3 630
	Meals (supper, child)	1 663	6	9 978
	Drinks for coffee breaks			68 882
	Welcome reception	2 160	37	79 920
	Drinks for welcome reception			47 070
	Excursion (winery tour)	1 800	35	63 000
	Bus for excursion to lake district			118 800
	Guide for excursion			21 600
	Entrance fee	300	29	8 700
	Entrance fee (child)	100	2	200
	Banquett	5 940	29	172 260
	Miscellaneous			19 881
	Total (JPY)			2 420 407