



SPring-8/SACLA Research Frontiers 2020

CONTENTS

Preface	5
Editor's Note	6
Scientific Frontiers	7
Review	
Recent progress in advanced SR characterization of fuel cells at SPring-8 <i>Y. Iwasawa</i>	8
Recent achievements using X-ray fluorescence holography and photoelectron holography <i>K. Hayashi and T. Matsushita</i>	12
Life Science	
Protein Crystallography: Crystal structure of the first orphan GPCR <i>X. Lin and F. Xu</i>	16
Protein Crystallography: Crystal structure of an antagonist-bound ghrelin receptor <i>Y. Shimura, S. Iwata and M. Kojima</i>	18
Protein Crystallography: Structural basis for the inhibition of <i>Plasmodium falciparum</i> hexose transporter <i>X. Jiang and N. Yan</i>	20
Protein Crystallography: Structural insights into isoform-selective regulators of mammalian Cryptochromes <i>S. Miller and T. Hirota</i>	22
Protein Crystallography: Structural basis of the intracellular interaction between type IIa receptor protein tyrosine phosphatases and Liprin- α <i>S. Fukui</i>	24
Protein Crystallization: A new powerful research tool for GPCR structure determination <i>H. Miyagi, S. Iwata and J. Saito</i>	26
Drug Delivery System: Characterizing DDS nanoparticles containing therapeutic DNAs or RNAs <i>M. Sakuragi and K. Sakurai</i>	28
Diabetes: Exercise regulates microRNAs to preserve coronary and cardiac function in the diabetic heart <i>D. O. Schwenke, K. Umetani and J. T. Pearson</i>	30
Cancer Chemotherapy: Visualization of platinum accumulation by synchrotron radiation X-ray fluorescence in cancer tumor of patients treated with oxaliplatin-based chemotherapy <i>M. Nishibori and R. Koba</i>	32
Physical Science	
Valence Electron Distribution: Direct determination of 3d orbital state in perovskite-titanate by synchrotron X-ray diffraction <i>S. Kitou and H. Sawa</i>	34
Gate Adsorption Kinetics: Time-resolved <i>in situ</i> X-ray powder diffraction measurements to clarify the kinetic nature of adsorption-induced structural transition on metal-organic frameworks <i>S. Hiraide, M. T. Miyahara and H. Tanaka</i>	36

Solid-liquid Interface: Early stages of iron passivation: defective growth of oxide layer observed by quick X-ray reflectometry <i>Y. Wakabayashi</i>	38
Quasi-elastic Scattering: Direct observation of molecular motions in soft materials: study of basic and applicational liquid crystal systems <i>M. Saito</i>	40
High-resolution Compton Scattering: Extreme Fermi surface smearing in maximally disordered NiFeCoCr solid solution <i>S. B. Dugdale</i>	42
Order within Disorder: Understanding diffraction patterns of disordered materials <i>S. Kohara, Y. Onodera and O. Sakata</i>	44
Liquid Structure: Very sharp diffraction peak in dense oxide liquid with the formation of distorted tetraclusters <i>C. Koyama, S. Kohara and T. Ishikawa</i>	46
Magnetic Compton Scattering: Depth dependence of spin-specific magnetic hysteresis loop observed by magnetic Compton scattering <i>N. Tsuji</i>	48
Optical Vortex: X-ray microscope for discriminating spiral orientation of structures inside materials <i>Y. Kohmura</i>	50
Phonon Softening: Nematic correlation length in iron-based superconductors probed by inelastic X-ray scattering <i>A. M. Merritt, F. Weber and D. Reznik</i>	52
Peritectic Solidification: Impact of massive-like ferrite to austenite transformation during and after solidification on microstructure evolution in steels <i>H. Yasuda</i>	54
Magnetization Reversal: Observation of magnetization reversal process for (Sm,Ce) ₂ (Co,Fe,Cu,Zr) ₁₇ magnets by soft X-ray magnetic circular dichroism microscopy <i>Y. Matsuura, R. Tamura, K. Ishigami and T. Nakamura</i>	56
HAXPES Depth Profiling: Skewing of electronic band along the direction of electric polarization in ferroelectrics <i>J. Kano and N. Oshime</i>	58
c-f Hybridization: Electronic structure of Yb compounds probed by hard X-ray photoemission spectroscopy <i>H. Sato</i>	60
Bulk Photovoltaic Effect: Evidence of Fermi level tuning in multiferroic BiFeO ₃ thin films by Mn doping for high photovoltage generation <i>S. Nakashima and H. Fujisawa</i>	62
Nano-beam XMCD: Time-resolved imaging of an operating hard-disk-drive write head using nanobeam X-ray magnetic circular dichroism <i>H. Suto, A. Kikitsu and Y. Kotani</i>	64
High-pressure Physics: High-pressure X-ray diffraction studies of the supercritical fluid of hydrogen <i>Y. Akahama</i>	66
 Cluster Dynamics: Ultrafast structural dynamics of highly excited nanoparticles in intense laser fields <i>T. N. Hiraki, Y. Kumagai, K. Nagaya and K. Ueda</i>	68
 Photo-induced Demagnetization: Studying ultrafast dynamics of element-dependent magnetization dynamics in ferromagnetic Co/Pt multilayer thin films using femtosecond X-ray magneto-optical Kerr effect measurement <i>K. Yamamoto and H. Wadati</i>	70
Nuclear Physics: Search for η' -meson bound nuclei using a GeV photon beam <i>N. Muramatsu and N. Tomida</i>	72

Chemical Science

- Crystal Volume Shrinkage:** Charge transfer transitions stemming from $6s^0$ and $6s^2$ charge degree of freedom in valence skipping Bi and Pb ions 74
M. Azuma, T. Nishikubo and Y. Sakai
- Catalysis:** Identification of Fe^{3+} single-atom sites for CO_2 conversion to CO using *operando* X-ray absorption spectroscopy 76
J. Gu, C.-S. Hsu, H. M. Chen and X. Hu
-  **Nonlinear Multiple Ionization:** Formation of Xe $4d$ double-core-hole states in intense EUV-FEL fields studied by multielectron-ion coincidence spectroscopy 78
M. Fushitani, Y. Hikosaka and A. Hishikawa
-  **Chemical Bond Formation:** Femtosecond X-ray liquidography captures the birth of molecular vibrations mediating bond formation 80
J. Goo-Kim, S. Adachi and H. Ihee
- Colorimetric Humidity Sensor:** A novel porous molecular crystal that varies its color in response to the change in surrounding humidity 82
H. Yamagishi and Y. Yamamoto
- Porous Material:** Structural characterization of acid-responsive hydrogen-bonded organic frameworks with permanent porosity 84
I. Hisaki and Y. Suzuki
- Molecular Cage:** Formation of large confined spherical space with small aperture using flexible hexa-substituted sumanene 86
Y. Yakiyama and H. Sakurai
- Artificial Ion Channel:** Tubular aggregate with hydrophilic interior formed by one-dimensional assembly of cyclic peptide amphiphile in nonpolar organic media 88
S. Kanazawa and I. Akiba
-  **Haem Dynamics:** Unravelling the “transition-state” of the respiratory function 90
M. Chergui
- Dioxin Formation:** Mechanistic investigation of chromium-chloride-promoted formation of dioxins by *in situ* XAFS 92
M. Zhang, T. Fujimori and M. Takaoka
- Radioactive Microparticle Analysis:** Characterization of two types of cesium-bearing microparticle (CsMP) emitted from the Fukushima nuclear power plant accident using multiple synchrotron radiation analyses 94
H. Miura and Y. Takahashi

Earth & Planetary Science

- Earth's Core:** Equation of state of liquid iron under extreme conditions 96
Y. Kuwayama and K. Hirose
- Earth's Mantle:** Viscosity measurement of silicate melts under mantle conditions infers the primordial structure of Earth's silicate mantle 98
L. Xie and A. Yoneda
- Earth Science:** Phase transition of aluminium hydroxide at extremely high pressure 100
M. Nishi
- Historical Geology:** What happened after the meteoroid impact at the end of the Cretaceous Period? - Paleoenvironmental reconstruction based on synchrotron XRF images 102
T. Maruoka
- Planetary Science:** *In situ* preservation of nitrogen-bearing organic matter in carbonates from ancient Mars 104
M. Koike, R. Nakada and T. Usui

Industrial Applications

Steel Structural Mechanics: Microscopic 3-dimensional stress distribution inside crystalline grains of bulk steel under plastic deformation measured by scanning 3-dimensional X-ray diffraction microscopy <i>Y. Hayashi, D. Setoyama and H. Kimura</i>	106
Polymer Science: Interpenetration of polymer chains on particle surfaces in latex films determined by small-angle X-ray scattering <i>T. Kureha</i>	108

Accelerators & Beamlines Frontiers 110

SPRING-8

Beam Performance - Recent update on accelerators	111
New Apparatus, Upgrades & Methodology	
<ul style="list-style-type: none"> • Development of X-ray imaging detector for 200 keV X-ray microtomography <i>M. Hoshino, K. Uesugi and N.Yagi</i> • A high-efficient X-ray emission spectrometer of SPRING-8 BL39XU beamline <i>N. Kawamura</i> 	112 114

SACLA

Beam Performance	116
-------------------------	-----

Facility Status 118

SPRING-8 Facility Status	119
Introduction	119
Machine Operation	120
Beamlines	121
User Program and Statistics	124
Research Outcome	127
Budget and Personnel	127
Research Complex	127
SPRING-8 Users Community (SPRUC)	130
Outreach Activities	131
SACLA Facility Status	132

Note: The principal publication(s) concerning each article is indicated with all author's names in italics in the list of references.