

SPring-8/SACLA Research Frontiers 2015

CONTENTS

Preface	5
Scientific Frontiers	7
Structural Biology of the Sodium Pump	8
High-Pressure Research on Superconductivity at SPring-8	12
Life Science	
 Structural Biology: Radiation damage-free structure of photosystem II at 1.95 Å resolution revealed by femtosecond X-ray pulses at SACLA <i>J.-R. Shen, F. Akita and M. Suga</i>	16
Structural Biology: Energy transfer pathways revealed from structural analysis of the plant PSI-LHCI supercomplex <i>M. Suga and J.-R. Shen</i>	18
Structural Biology: Visualization of agonistic and inhibitory DNA recognition by Toll-like receptor 9 <i>T. Shimizu</i>	20
Structural Biology: Crystal structures of the human adiponectin receptors <i>H. Tanabe, T. Yamauchi, T. Kadowaki and S. Yokoyama</i>	22
Structural Biology: Absolute slowness encoded in the circadian clock protein KaiC <i>J. Abe, A. Mukaiyama and S. Akiyama</i>	24
 Crystallography Technique: Grease matrix method for serial femtosecond crystallography using XFELs <i>M. Sugahara, E. Nango and S. Iwata</i>	26
 Crystallography Technique: <i>De novo</i> phasing with serial femtosecond crystallography at SACLA <i>T. Nakatsu, K. Yamashita and S. Iwata</i>	28
Cell Motility: X-ray diffraction patterns from flagellar axonemes of <i>Chlamydomonas</i> <i>S. Toba and K. Oiwa</i>	30
Respiratory Medicine: Imaging the airway surface to test Cystic Fibrosis treatments <i>K. Morgan, M. Donnelley, D. Parsons and K. Siu</i>	32
Dentistry: Distribution analyses of trace metallic elements in oral mucosal tissues using high-energy SR-XRF <i>M. Uo</i>	34
Evolution: Structural mouthpart interaction evolved already in the earliest lineages of insects <i>A. Blanke and R. Machida</i>	36
Physical Science	
Magnetism: Ferromagnetically coupled stellated cuboctahedral spin nanocage <i>S. Kang and O. Sato</i>	38
Magnetism: Imaging and controlling all-in/all-out magnetic domains in pyrochlores <i>S. Tardif</i>	40
Magnetism: Competition and collaboration between magnetism and superconductivity: Electronic structures of ferromagnetic superconductors UGe ₂ , URhGe, and UCoGe <i>S. Fujimori</i>	42
Magnetism: Linking phonons in SrFe ₂ As ₂ to magnetic fluctuations <i>A. Q. R. Baron, N. Murai, T. Fukuda and S. Tajima</i>	44

Magnetism: Discovery of suboxidic coordinate in high- T_c ferromagnetic semiconductor Co-doped TiO_2	46
<i>W. Hu, K. Hayashi and T. Fukumura</i>	
Strongly Correlated System: Strongly correlated ground-state orbital symmetry of tetragonal and cubic Yb compounds probed by linear dichroism in <i>angle-resolved</i> core-level photoemission	48
<i>A. Sekiyama, Y. Kanai and S. Imada</i>	
Condensed Matter Physics: Characterization of local strain in $\text{Ge}_{1-x}\text{Sn}_x/\text{Ge}$ fine structures by using microdiffraction	50
<i>O. Nakatzuka, S. Ike and S. Zaima</i>	
Condensed Matter Physics: Copper oxide without static Jahn-Teller distortion	52
<i>N. Katayama, H. Sawa and S. Nakatsuji</i>	
Condensed Matter Physics: Site-specific valence atomic orbital characterization by detection of angular-momentum-polarized Auger electrons	54
<i>F. Matsui</i>	
Amorphous Material: Structure of an extremely fragile liquid	56
<i>S. Kohara and K. Ohara</i>	
Liquid Metal: Remarkable dispersion of the acoustic mode in liquid Bi linked to Peierls distortion	58
<i>M. Inui, Y. Kajihara, S. Munejiri and A. Q. R. Baron</i>	
X-ray Physics: Proposal to generate an isolated monocycle X-ray pulse by counteracting the slippage effect in free-electron lasers	60
<i>T. Tanaka</i>	
Atomic Physics: Nanoplasma formation in rare-gas clusters ignited by intense X-ray free-electron laser pulses from SACLA	62
<i>H. Fukuzawa, T. Tachibana and K. Ueda</i>	



Chemical Science

Fuel Cell Research: Surface-regulated Nano- $\text{SnO}_2/\text{Pt}_3\text{Co}/\text{C}$ cathode catalysts for polymer electrolyte fuel cells prepared by a new Sn deposition method	64
<i>K. Nagasawa, S. Takao and Y. Iwasawa</i>	
Battery Research: Breakthrough in energy density of lithium ion batteries by spectroscopic X-ray diffraction	66
<i>K. Fukuda, T. Kawaguchi and E. Matsumura</i>	
Battery Research: Understanding a battery with high-energy X-ray Compton scattering	68
<i>Y. Sakurai and M. Ito</i>	
Nanoscience: Ultrathin inorganic molecular nanowires based on transition metal oxide	70
<i>Z. Zhang, T. Murayama, N. Yasuda and W. Ueda</i>	
Nanoscience: Role of liquid indium in the structural purity of wurtzite InAs nanowires that grow on Si(111)	72
<i>A. Biermanns-Föth, E. Dimakis and U. Pietzsch</i>	
Nanoscience: Bonding and electronic states of boron in silicon nanowires characterized by infrared synchrotron radiation beam	74
<i>N. Fukata, Y. Ikemoto and T. Moriwaki</i>	
Molecular Chemistry: Direct observation of bond formation in solution with femtosecond X-ray scattering	76
<i>J. G. Kim, H. Ihee and S. Adachi</i>	
Molecular Chemistry: Fast ortho-para conversion of H_2 observed in a coordination nanospace	78
<i>E. Nishibori, T. Kosone and M. Ohba</i>	
Molecular Chemistry: Visualizing photoinduced intramolecular electron transfer	80
<i>S. E. Canton, K. S. Kjaer and M. M. Nielsen</i>	
Amorphous Material: Melting of Pb charge glass and simultaneous Pb-Cr charge transfer in PbCrO_3 as the origin of volume collapse	82
<i>R. Yu and M. Azuma</i>	

Organic Thin Film: Successful formation of uniform organic thin films of macroscopic size by rational space-filling design <i>Y. Shoji, T. Kajitani and T. Fukushima</i>	84
Polymer Science: Quantitative design of fiber strength by the structural development analysis of PET <i>Y. Ohkoshi</i>	86
Gas Storage: Oxygen storage capability of BaYMn ₂ O _{5+δ} studied by high-temperature X-ray diffraction under precisely controlled oxygen pressures <i>T. Motohashi, Y. Kubota and H. Kageyama</i>	88
Catalysis: Fe ⁴⁺ -based quadruple perovskite catalyst for oxygen evolution reaction <i>I. Yamada and S. Yagi</i>	90
Surface Reaction: Reaction of CO ₂ on the stepped Cu(997) surface revealed by ambient-pressure X-ray photoelectron spectroscopy <i>S. Yamamoto, T. Koitaya and J. Yoshinobu</i>	92
Cross-coupling Reaction: Mechanistic investigation of iron-catalyzed Kumada-Tamao-Corriu-type cross-coupling reactions based on solution-phase XAFS <i>H. Takaya, S. Nakajima and M. Nakamura</i>	94
Environmental Science: Accumulation and distribution of cesium in <i>Egeria densa</i> , a submerged plant <i>E. Harada, Y. Nagakawa and A. Hokura</i>	96
Environmental Science: Chemical forms of cesium in ashes generated from municipal solid waste incineration <i>K. Oshita, K. Shiota and M. Takaoka</i>	98
Environmental Science: Arsenic distribution and speciation around rice roots <i>N. Yamaguchi</i>	100
Environmental Science: Mercury sulfide formation process under mechanochemical reaction using a planetary ball mill <i>N. Fukuda and M. Takaoka</i>	102

Earth & Planetary Science

Earth Science: Speed of sound in liquid Fe-C alloy under high pressures using inelastic X-ray scattering <i>Y. Nakajima, S. Imada, K. Hirose and A. Q. R. Baron</i>	104
Earth Science: Magma fracturing and friction: Implications for volcanic eruptions <i>S. Okumura</i>	106
Earth Science: Grain boundary sliding as the major flow mechanism of Earth's upper mantle <i>T. Ohuchi, T. Irifune and Y. Higo</i>	108
Planetary Science: Curious kinetic behavior in silica polymorphs solves seifertite puzzle in shocked meteorite <i>T. Kubo and T. Kato</i>	110

Industrial Applications

Battery Research: Analyzing reaction mechanism of Li-ion secondary battery by element-specific <i>in situ</i> X-ray absorption spectroscopy and theoretical spectral simulations <i>H. Imai, M. Mogi and K. Kubobuchi</i>	112
Material Mechanics: Scanning three-dimensional X-ray diffraction microscopy for non-destructive observation of plastic deformation in metallic materials <i>Y. Hayashi, Y. Seno and D. Setoyama</i>	114
Polymer Science: Enhancement of out-of-plane mobility in P3HT film: Face-on orientation produced by rubbing <i>D. Kajiya, T. Koganezawa and K. Saitow</i>	116
Nanoscience: Formation of stable self-assembled multilayer palladium nanoparticles for ligand-free coupling reactions <i>N. Hoshiya, S. Shuto and M. Arisawa</i>	118

Accelerators & Beamlines Frontiers 120

SPRING-8

Beam Performance 121

Controls & Computing 122

Development, implementation and operation of MADOCaII middleware for accelerator and beamline control 122

A. Yamashita and T. Matsushita

SACLA

Beam Performance 126

New Apparatus, Upgrades & Methodology 128

• Highly efficient arrival time diagnostics for SACLA 128

T. Sato and M. Yabashi

• Experimental platform for serial femtosecond crystallography at SACLA 130

K. Tono, S. Iwata and M. Yabashi

• Signal enhancement and Patterson-search phasing for higher-spatial-resolution coherent X-ray diffraction imaging of biological objects 132

Y. Takayama and K. Yonekura

• Time-resolved hard X-ray photoelectron spectroscopy using SACLA: Investigation of space-charge effects induced with optical pump and X-ray probe pulses 134

L.-P. Oloff, K. Rossnagel and M. Oura

Facility Frontiers 136

SPRING-8 Facility Status 137

SACLA Facility Status 146

NewSUBARU 148

Low energy soft X-ray emission spectrometer at BL-09A in NewSUBARU 149

M. Nabe

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