2021 UNISOKU NEWSLETTER

Let the global pandemic be blown out!

Business Policy

経営方針

UNISOKU Co., Ltd. was founded by Dr. Toshihiko Nagamura in 1974 with the spirit of his frontier mentality, "Provide unique measurement systems to the society". In 2010, we joined Tokyo Instruments(TII) Group, the worldwide trading group for advanced scientific instruments. Under the former President, Shoji Suruga, UNISOKU promoted globalization and capital investment and succeeded in expanding our sales worldwide.

We keep listening to our customers, continuously improve our systems, and visit them until their systems work properly and positive outcomes are obtained. This is our basic policy to build a bond with our customers. We strive to develop unique instruments that can provide significant impacts and create new values in the society, and continue to grow in the constantly changing world. A variety of innovative measurement systems have been continuously produced from UNISOKU, including not only very low temperature/high magnetic field STM systems but also tip-enhanced Raman spectroscopy systems possessing molecule-scale spatial resolution, cryogen-free STM systems, and



President and CEO, Yutaka Mivatake

optical instruments such as picoTAS, which enables us to measure over a wide range of time scales including "Gap Time Region" by utilizing our own RIPT method.

It is our mission and the origin of our growth to listen to our customers and provide them happiness and invaluable experience by offering solutions to their problems with our skills and knowledge. We continue to challenge and never give up until our products meet the customers' needs, and strive to further improve our products and service.

株式会社ユニソクは、1974年に初代社長である長村俊彦氏の「ユニークな測定器を世の中に提供していく」というチャレンジ精神に より誕生しました。2010年には、研究用計測機器の販売を行う株式会社東京インスツルメンツ(TII)のグループ会社となり、当時の同社 社長、駿河正次氏を2代目社長として迎え、グローバル化と設備投資を進め、成長を遂げました。

弊社は、お客様の声に耳を傾け、改良を重ね、お客様の成果が出るまでお付き合いをさせていただくことを大切にしてきました。 私たちは計測を通して社会に役立つオンリーワン、ナンバーワンの価値を生み出し、変化に強い会社として成長を続けることを目指 しています。極低温強磁場STM装置の他にも、分子スケールの空間分解能を持つ探針増強ラマンSTM製品や、液体ヘリウムを使わない 次世代無冷媒STM製品、分光製品では、従来法では困難だった時間領域を独自の計測技術(RIPT法)を用いて計測するピコ秒過渡吸収分 光製品(picoTAS)などユニークな計測装置を次々と世に送り出しております。

お客様の声に耳を傾け、課題解決を知恵と工夫で提案することにより、感動と幸福を与え続けることが我々の使命であり成長の源 であると考えます。これからも満足していただけるまであきらめない姿勢で挑戦を続け、より良い製品とサービスの提供に取り組ん でまいります。

Our Policy for Delivery and Repair Visit Work due to COVID-19 COVID-19の世界的感染に伴う納品・修理訪問の方針

Due to the pandemic COVID-19, we sincerely apologize for any late deliveries and suspending our on-site visit work. Regarding restarting our on-site visit work, UNISOKU must follow the immigration policy announced by the Government of Japan for each country. Although it is difficult to restart traveling abroad depending on area, we do our best to keep this inconvenience to a minimum by offering online support and/or local support by the SPECS-TII group. We deeply appreciate your kind understanding in this regard. We are also grateful to our suppliers for their efforts to provide us products and keep their production lines running during this difficult situation.

COVID-19の世界的感染拡大により、納品の遅れやお客様への訪問サービスの提供が滞っておりますことを心よりお詫び申し上げます。 弊社からの出張の再開に関しましては、日本政府による各国ごとの渡航安全基準と渡航先の入国基準に従う方針です。地域によっては 渡航の再開は困難な状況ですが、オンラインサポートの提案、SPECS-TIIグループによるローカルサポートの活用など、お客様のご不便を 低減するよう努力してまいります。これまでご理解をくださいましてありがとうございます。また弊社へのサプライヤーの皆様におか れましては生産能力の確保が厳しい中、弊社への製品提供にご尽力くださり感謝いたします。

SPECS-TIL Group

SPECS-TIIグループ

UNISOKU joined TII group as a subsidiary company in 2010. In 2017, TII Group and SPECS GmbH established a joint company, SPECS-TII GmbH in Switzerland, for strengthening their worldwide sales and support. SPECS-TII GmbH then established local firms in China, Russia and the United States for sales and support in those areas. UNISOKU and SPECS-TII aim to provide further reassurance and service for our customers using our global network.

ユニソクは2010年に株式会社東京インスツルメンツの子会社としてTIIグループに加わりました。TIIグループはドイツSPECS GmbHと ともに両社の製品の販売とサポートを世界的に協力する目的で2017年にホールディングカンパニー SPECS-TII GmbHをスイスに設立し ました。SPECS-TII GmbHは、販売とサービスの拠点として中国、ロシア、米国に現地法人を立ち上げました。ユニソクはSPECS-TIIのグロー バル連携のネットワークを使い、お客様へのさらなる安心とサービスの提供を目指してまいります。

Corporate Philosophy 経営理念

UNISOKU contributes to the development of science and technology by providing customers with measurement systems that meet their exploring minds.

お客様の探究心に応える計測を提供し、お客様の成果を通じて、科学技術の発展に貢献する。



Challenge courageously

Even in difficult situations, we try something new with our strong will.

Think positively and look from others' standpoints

We express our gratitude. We achieve goals through mutual cooperation. We think from the standpoints of customers, partners and colleagues, and provide value for them.

Create values

To meet ever-changing social needs, we aim to create values 常に変化する世の中のニーズに応え、知恵と工夫で、幸福 that provide happiness and impressive experience to customers と感動を与える価値を創造することを目指します。 by our knowledge and skills.

Pursue happiness

仕事を通じて、顧客や同僚とともに歩み、分かち合える We work to share happiness with our customers and colleagues. 幸福を見つけることを目指します。











COMPANY PROFILE 会社概要

TRADE NAME (商号) FOUNDATION (設立) **LOCATION**(所在地) **CAPITAL**(資本金) BUSINESS (事業)

UNISOKU CO., LTD. (株式会社ユニソク) CEO(代表取締役社長) Yutaka Miyatake (宮武 優) NOV. 1974 (昭和 49 年 11 月) 2-4-3 Kasugano, Hirakata, Osaka, Japan (大阪府枚方市春日野 2 丁目 4 番 3 号) 50.000.000 JPY (5,000 万円) (走査型プローブ顕微鏡、高速分光装置製造販売「研究開発分野」にて事業)

MEMBERS(社員数)

49 (49 名)

果敢に挑戦

困難なことでも強い意志を持って果敢に挑戦することを 目指します。

物事を前向きに、相手の立場で考える

感謝の気持ちを示し、互いに協力しながら目標を達成する ことを目指します。 顧客・取引先・同僚の視点で考え、相手にとって価値ある ことの提供を目指します。

価値の創造

幸福の追求



Manufacturing and sales of our own UHV LT SPMs and Optical spectroscopy systems, research and development

2020 Events in



New Faces 新入社員紹介

New members have joined UNISOKU in 2020-21. 2020-21年 新しいメンバーが加わりました。

Design

設計課

Division



03



We decided to hire him as a full-time employee from a contractual worker because we recognize his sincere attitude and speed to learn a new job. We expect him to have more experience in production and contribute to the production of high quality systems.

半年間の派遣会社からの就業を通し、仕事に真摯に取り組む姿勢と習得の早さを 評価して採用しました。生産・組立の経験を積み、質の高い製品を作り上げることを 期待しています。











His experience in mechanical design is attractive for us. We expect him to understand mechanical structures of UNISOKU products and become a designer who can propose appropriate designs to our customers in the future.

機械機器の設計の経験に魅力を感じ、採用しました。まずはユニソクの製品の機構 を理解し経験を重ね、ユーザーの希望の機能を発現する適切な構造を提案できる ような設計者になることを期待しています。

Product Development News in 2020

Highly Hydrogen-Sensitive Thermal Desorption Spectroscopy (TDS) System 高感度水素TDS(昇温脱離ガス分析法)システム

Optical fiber for laser Measuremen chambe oad-lock chambe Quadrupole mass

~10³ higher sensitivity to hydrogen than other commercial TDS systems

Arbitrary heating rate between 10-100°C/min for 150-1000°C

This work was in collaboration with Prof. Hosono's group (Tokyo Institute of Technology) and supported by Ichimura Foundation for New Technology.





0 Sample Bias (mV)

UHV Kelvin Probe/Photoemission Spectroscopy System 超高真空ケルビンプローブ・光電子分光システム



Raman Spectroscopy System for Thin Films Under Various Environmental Conditions 環境制御型 薄膜ラマン分光システム



Japan Atomic Energy Agency Dr. Terasawa Tomo-o

Hall Effect Measurement System for the Autonomous Synthesis System ホール効果測定装置システム





Scanning Noise Microscope (SNoiM)

GaAs nano-device

SEM image

Electron temperature mapping





• Base temperature below $T_{\text{sample}} = 5 \text{ K}$ Low vibration noise level realized by our original design

- · Kelvin probe by KP Technology Ltd.
- Sample transfer & exchange in UHV conditions
- Variable sample temperature

Applications

In-situ work function & surface potential measurements for thin films and clean surfaces prepared in vacuum Distributor



2020年 製品開発

Combination with Nanofinder® by Tokyo Instruments, Inc. · Sample transfer & exchange in UHV conditions Raman spectroscopy measurements under gaseous/heating environments

Applications

 Thin films grown by CVD/MBE · Variable temperature measurements Surface-adsorbed molecules at low temperatures

Designed for automatic Hall effect measurements and sample transfer by a robot arm

This work was in collaboration with Prof. Hitosugi's group (Tokyo Institute of Technology) and MI-6 Ltd. as a part of their NEDO project.

e(K)	Real-space imaging of electron temperature with papometer-scale spatial resolution
1700	Q. Weng <i>et al</i> . Science 360 , 775 (2018).

1000 This work is in collaboration with Dr.s Weng and Komiyama (Kim group in RIKEN). 300

Products / Users / Publications

Publication Stats in 2020

Total number of publications using UNISOKU systems* = 246 (240 in 2019) Total impact factors ~ 1898 (1720 in 2019) Corresponding to 44 Nature papers (40 in 2019) Impact factor per employee ~ 40 (~36 in 2019)

Approaching to the impact factor of Nature (~43)

Popular Research Fields	Num. of Publications	Average Impact Factor
Molecules	32	7.97
Topological Materials (Majorana)	31	15.77
Graphene (Twisted Bi-layer Graphene)	25	8.48
Transition Metal Dichalcogenides (TMDs)	21	10.69
Low Dimensional Structures (Nanowire, Low Dimensional Superconductivity, etc)	21	7.28
RIPT Transient Absorption	13	8.17
Monatomic Films excluding TMDs	10	10.18
Fe-based Superconductors (FeSe/STO)	9	12.50

USM1200

Ultra High Vacuum Low Temperature SPM System

Solution for long-term measurements with low cost cryogen

Application fields: molecules, transition metal dichalcogenides, low-dimensional structures

USM1200 Publication List in 2020 (Selected) (論文リスト

"Reconfigurable Photo-Induced Doping of Two-Dimensional Van Der Waals Semiconductors Using Different Photon Energies" S. Seo et al. Nat. Electron. 4, 38 (2021).

超高真空低温走査型プローブ顕微鏡システム

"Synthesis of Monolayer Blue Phosphorus Enabled by Silicon Intercalation" J. L. Zhang et al., ACS Nano 14, 3687 (2020).

"Steering Effect of Bromine on Intermolecular Dehydrogenation Coupling of Poly(p-phenylene) on Cu(111) Y. Lin et al., ACS Nano 14, 17134 (2020).

"Orbital-Selective Dirac Fermions and Extremely Flat Bands in Frustrated Kagome-Lattice Metal CoSn" Z. Liu et al., Nat. Commun. 11, 4002 (2020).

"On-surface Synthesis of Nitrogen Substituted Gold-Phosphorus Porous Network" J. Zhang et al., Chem. Mater. 32, 8561 (2020).

"Molecular-Scale Investigation of the Thermal and Chemical Stability of Monolayer PTCDA on Cu(111) and Cu(110)" C. Gu et al., ACS Appl. Mater. Interfaces 12, 22327 (2020).

"Single-Molecule Imaging of Dinitrogen Molecule Adsorption on Individual Iron Phthalocyanine" C. Gu et al., Nano Res. 13, 2393 (2020).

"Realization of a Buckled Antimonene Monolayer on Ag(111) via Surface Engineering" S. Sun et al. J. Phys. Chem. Lett. 11, 8976 (2020)

The detailed information about the publication list is available on our website. *including preprints





USM1400

Ultra High Vacuum Low Temperature SPM System

Ideal system for combining SPM with optical options and extending to a multi-probe platform

Application fields:

graphene, tip-enhanced Raman spectroscopy, scanning tunneling potentiometry, etc.



USM1400 Publication List in 2020 (Selected)

"Sub-Nanometre Resolution in Single-Molecule Photoluminescence Imaging' B. Yang et al., Nat. Photonics 14, 693 (2020)

"Reversible Superconductor-Insulator Transition in (Li, Fe)OHFeSe Flakes Visualized by Gate-Tunable Scanning Tunneling Spectroscopy" R. Yin et al., ACS Nano 14, 7513 (2020).

"Experimental Realization of Two-Dimensional Buckled Lieb Lattice" H. Feng et al., Nano Lett. 20, 2537 (2020).

"Dramatic Enhancement of Tip-Enhanced Raman Scattering Mediated by Atomic Point Contact Formation" S. Liu et al., Nano. Lett. 20, 5879 (2020).

"Interfacial Superconductivity in FeSe Ultrathin Films on SrTiO, Probed by In Situ Independently Driven Four-Point-Probe Measurements" A. K. Pedersen et al., Phys. Rev. Lett. 124, 227002 (2020).

"Tunable Lattice Reconstruction, Triangular Network of Chiral One-Dimensional States, and Bandwidth of Flat Bands in Magic Angle Twisted **Bilayer Graphene'**

Y. Liu et al., Phys. Rev. Lett. 125, 236102 (2020)

"The Structure and Mechanism of Large-Scale Indium-Intercalated Graphene Transferred from SiC Buffer Layer" T. Hu et al., Carbon 171, 829 (2021).

"Phase-Resolved Detection of Ultrabroadband THz Pulses Inside a Scanning Tunneling Microscope Junction" M. Muller et al., ACS Photonics 7, 2046 (2020).

"Tunable Magnetism of a Single-Carbon Vacancy in Graphene" Y. Zhang et al., Sci. Bull. 65, 194 (2020).

"Anisotropic Gapping of Topological Weyl Rings in the Charge-Density-Wave Superconductor In, TaSe," Y. Li et al., Sci. Bull. DOI: 10.1016/i.scib.2020.09.007

"Sub-Nanometre Resolution in Single-Molecule Photoluminescence Imaging" B. Yang et al., Nat. Photonics, 14, 693 (2020). Product used: USM1400

Sub-nanometer resolution imaging with scanning near-field optical microscopy (SNOM) has long been a challenge. Yang et al. (Dong group, Univ. of Science and Technology of China) demonstrated spatially and spectrally resolved photoluminescence imaging of a single zinc phthalocyanine (ZnPc) molecule with a spatial resolution down to 0.8 nm. The unprecedented spatial resolution was achieved by (1) a strongly localized-and-enhanced plasmon field using a Ag tip with an atomistic protrusion on the apex, (2) a three-monolayer-thick NaCl dielectric spacer to electronically decouple the ZnPc molecule from a plasmonic substrate Ag(100), and (3) the precise control of the tip-sample tunneling junction with sub-nanometer scale. They revealed intriguing photophysics of molecular fluorescence enhancement and guenching, and subtle plasmon-molecule interactions at the sub-molecular level, providing a new way for optical imaging, spectroscopy and engineering of light-matter interactions at the sub-nanometer level.



(b) TEPL photon in

(a) Experimental set-up.

(b) Tip-enhanced photoluminescence image of a single ZnPc molecule on NaCl/Ag(100). (c) Line-profile along AB in (b), showing the spatial resolution of 0.8 nm







USM1300

Ultra High Vacuum Very Low Temperature High Magnetic Field SPM System

超高真空極低温強磁場中走査型トンネル顕微鏡システム

Best-selling very low temperature SPM system

Application fields: topological matters (Majorana), twisted bi-layer graphene, monolaver superconductors etc.

USM1300 Publication List in 2020 (Selected) 論文リスト

"Chiral Superconductivity in Heavy-Fermion Metal UTe2" L. Jiao et al., Nature 579, 523 (2020)

"Quantum-Limit Chern Topological Magnetism in TbMn₆Sn₆" J. Yin et al., Nature 583, 533 (2020)

"Topological Superconductivity in a Van Der Waals Heterostructure" S. Kezilebieke et al., Nature 588, 424 (2020).

"Evidence for Dispersing 1D Majorana Channels in an Iron-Based superconductor" Z. Wang et al., Science 367, 104 (2020).

"Nearly Quantized Conductance Plateau of Vortex Zero Mode in an Iron-Based Superconductor" S. Zhu et al., Science 367, 189 (2020)

"Visualizing Coexisting Surface States in the Weak and Crystalline Topological Insulator Bi2Tel" N. Avraham et al., Nat. Mater. 19, 610 (2020)

"Topological Frustration Induces Unconventional Magnetism in a Nanographene" S. Mishra et al., Nat. Nanotechnol. 15, 22 (2020).

"Superhigh Uniform Magnetic Cr Substitution in a 2D Mo₂C Superconductor for a Macroscopic-Scale Kondo Effect " C. Xu et al., Adv. Mater. DOI: 10.1002/adma.202002825

"Epitaxial Growth of Single-Phase 1T'-WSe2 Monolayer with Assistance of Enhanced Interface Interaction" W. Chen et al. Adv. Mater. DOI: 10.1002/adma.202004930

"Interfacial Hydrogen-Bonding Dynamics in Surface-Facilitated Dehydrogenation of Water on TiO₂(110)" S. Tan et al., J. Am. Chem. Soc. 142, 826 (2020)

"Proximity-Induced Superconductivity in Monolayer MoS₂" D. J. Trainer et al., ACS Nano 14, 2718 (2020)

"Direct Observation of One-Dimensional Peierls-type Charge Density Wave in Twin Boundaries of Monolayer MoTe2" L. Wang et al., ACS Nano 14, 8299 (2020).

"An Anomalous Magneto-Optic Effect in Epitaxial Indium Selenide Layers" W. Fu et al., Nano Lett. 20, 5330 (2020).

"Relativistic Artificial Molecules Realized by Two Coupled Graphene Quantum Dots" Z. Fu et al., Nano Lett. 20, 6738 (2020).

"Nearly Quantized Conductance Plateau of Vortex Zero Mode in an Iron-Based Superconductor" S. Zhu, L. Kong, L. Cao, H. Chen et al., Science 367, 189 (2020). Product used: USM1300

The search for topological superconductors has been recently one of central issues in the condensed matter physics. In a vortex core of the topological superconductor, Majorana bound states are predicted to exist at zero energy and obey Non-Abelian statistics, offering potential applications in topological quantum computation. However, experimental demonstrations have remained challenging. Zhu et al. (Gao group, Chinese Academy of Sciences) performed variable-tunnel-coupled STS measurements at T_{eff} = 377 mK on vortex cores in FeTe_{0.55}Se_{0.45}, a strong candidate for the topological superconductor. They observed nearly quantized conductance plateaus as a function of tunnel coupling for zero-energy bound states, whereas no plateaus were observed on finite energy bound states originating from conventional quasipartcles. The plateau behavior of the zero-bias conductance is theoretically supported as spectroscopic evidence for the existence of Majorana bound states. Their study moves one step further toward the braiding operation in topological quantum computation.



(a) A variable tunnel coupling STM/STS for a vortex core of $FeTe_{0.55}Se_{0.45}$ (b) dl/dV spectra taken at the vortex core as a function of the tunnel coupling (T_{eff} = 377 mK). (c) (top) A color-scale plot of (b). (middle) Line-cut at V = 0 meV, showing a conductance plateau. (bottom) Line-cuts at high V values, showing the absence of the conductance plateau.



USM1300 Publication List in 2020 (Selected) 論文リスト

"Precise Tuning of Band Structures and Electron Correlations by van der Waals Stacking of One-Dimensional W6Te6 Wires" J. Deng et al., Nano Lett. 20, 8866 (2020).

"Mottness Versus Unit-Cell Doubling as the Driver of the Insulating State in 1T-TaS₂" C. J. Butler et al., Nat. Commun. 11, 2477 (2020).

"Molecular Molds for Regularizing Kondo States at Atom/Metal Interfaces" X. Li et al., Nat. Commun. 11, 2566 (2020).

"Fermion-Boson Many-Body Interplay in a Frustrated Kagome Paramagnet" J Yin et al Nat Commun 11 4003 (2020)

"Spin-Orbit Quantum Impurity in a Topological Magnet" J. Yin et al., Nat. Commun. 11, 4415 (2020).

"Long-Range Focusing of Magnetic Bound States in Superconducting Lanthanum" H. Kim et al., Nat. Commun. 11, 4573 (2020).

"Imaging the Coupling Between Itinerant Electrons and Localised Moments in the Centrosymmetric Skyrmion Magnet GdRu₂Si₂" Y. Yasui et al., Nat. Commun. 11, 5925 (2020).

"Single Particle Tunneling Spectrum of Superconducting Nd_{1-x}Sr_xNiO₂ Thin Films" Q. Gu et al., Nat. Commun. 11, 6027 (2020).

"A New Majorana Platform in an Fe-As Bilayer Superconductor" W. Liu et al., Nat. Commun. 11, 5688 (2020).

"Atomically Thin Superconductors" Z. Li et al., Small DOI: 10.1002/smll.201904788

"Valley Polarization and Inversion in Strained Graphene via Pseudo-Landau Levels, Valley Splitting of Real Landau Levels, and Confined States" S. Li et al., Phys. Rev. Lett. 124, 106802 (2020).

"Movable Valley Switch Driven by Berry Phase in Bilayer-Graphene Resonators" Y. Liu et al., Phys. Rev. Lett. 124, 166801 (2020).

"Many-Body Resonance in a Correlated Topological Kagome Antiferromagnet" S. Zhang et al., Phys. Rev. Lett. 125, 046401 (2020).

"Strain Tunable Semimetal-Topological-Insulator Transition in Monolayer 1T'-WTe2" C. Zhao et al., Phys. Rev. Lett. 125, 046801 (2020).

"Direct Visualization of Ambipolar Mott Transition in Cuprate CuO₂ Planes" Y. Zhong et al., Phys. Rev. Lett. 125, 077002 (2020).

"Local Berry Phase Signatures of Bilayer Graphene in Intervalley Quantum Interference" Y. Zhang et al., Phys. Rev. Lett. 125, 116804 (2020).

"Multiple In-Gap States Induced by Topological Surface States in the Superconducting Topological Crystalline Insulator Heterostructure Sn_{1-x}Pb_xTe-Pb" H. Yang et al., Phys. Rev. Lett. 125, 136802 (2020).

"Superconductivity in a Hole-Doped Mott-Insulating Triangular Adatom Layer on a Silicon Surface" X. Wu et al., Phys. Rev. Lett. 125, 117001 (2020).

"Observation of Discrete Conventional Caroli-de Gennes-Matricon States in the Vortex Core of Single-Layer FeSe/SrTiO," C. Chen et al. Phys. Rev. Lett. 124, 097001 (2020).

"Chiral Superconductivity in Heavy Fermion Metal UTe₂" .. Jiao et al., Nature 579, 523 (2020). Product used: USM1300

Spin triplet superconductors consisting of electron pairs with spin 1 and an odd-parity wavefunction are topologically nontrivial and expected to provide an ideal platform for realizing Majorana edge states but extremely rare in solid state systems. Jiao et al. (Vidya Madhavan group, University of Illinois) performed STM measurements on the recently discovered heavy fermion superconductor UTe₂ ($T_c = 1.6$ K) and found clear signatures of competing Kondo effect and superconductivity within one unit cell. They also revealed 'chiral' in-gap states at step edges, which are theoretically predicted to exist at the boundaries of topological superconductors. Their result suggests that UTe₂ is a strong candidate for chiral triplet topological superconductivity.





(a) STM image of UTe₂. (b,c) *dl/dV* spectra taken at the location denoted in (a), showing the Kondo resonance and the superconducting gap, respectively. (d) STM image of UTe₂ with a terrace. (e) *dl/dV* spectra measured at the step edge marked by dots in (d), showing the chiral in-gap states.



招高真空低温強磁場中走査型プローブ顕微鏡システム Ultra High Vacuum / Low Temperature / High Magnetic Field SPM System

Compact cryogenic high magnetic field SPM system

Application fields: monolayer films, topological matters, transition metal dichalcogenides etc.

USM1500 Publication List in 2020 (Selected) (論文リスト

"Packing Sierpiński Triangles Into Two-Dimensional Crystals" Y. Zhang et al., J. Am. Chem. Soc. 142, 17928 (2020).

"Te-Vacancy Induced Surface Collapse and Reconstruction in Antiferromagnetic Topological Insulator MnBi₂Te₄" F. Hou et al., ACS Nano 14, 11262 (2020).

"Kinetics-Limited Two-Step Growth of Van Der Waals Puckered Honeycomb Sb Monolayer" Z. Shi et al., ACS Nano 14, 16755 (2020).

"Charge Density Modulation and the Luttinger Liquid State in MoSe, Mirror Twin Boundaries" Y. Xia et al., ACS Nano DOI: 10.1021/acsnano.0c05397

"Distinct Topological Surface States on the Two Terminations of MnBi₄Te₇" X. Wu et al., Phys. Rev. X 10, 031013 (2020).

"Atomic-Scale Observation of Topological Vortices in the Incommensurate Charge Density Wave of 2H-TaSe2" S. Lim et al., Nano Lett. 20, 4801 (2020).

"Tuning the Electronic Structure of an α-Antimonene Monolayer Through Interface Engineering" Z. Shi et al., Nano Lett. 20, 8408 (2020).

"Direct Observation of Full-Gap Superconductivity and Pseudogap in Two-Dimensional Fullerides" M. Ren et al., Phys. Rev. Lett. 124, 187001 (2020).

"Reversible Potassium Intercalation in Blue Phosphorene-Au Network Driven by an Electric Field" Y. Liu et al., J. Phys. Chem. Lett. 11, 5584 (2020).

"Heterostructures of Tellurium on NbSe, from Sub-Monolayer to Few-Layer Films" J. Xian et al., Nanoscale 12, 1994 (2020).

"Packing Sierpiński Triangles into Two-Dimensional Crystals" Y. Zhang et al., J. Am. Chem. Soc. 142, 17928 (2020). Product used: USM1500

Two-dimensional (2D) fractal patterns such as the Sierpiński triangles (STs) are theoretically predicted to exhibit intriguing optical and electronic properties due to their aperiodic but ordered structures. However, realizing large-scale 2D crystals has remained challenging. Zhang et al. (Yongfeng Wang group, Peking Univ.) succeeded in constructing a series of 2D packed crystals of STs consisting of 1,3-bis (4-pyridyl) benzene (BPyB) molecules and Fe atoms on Au surfaces. Their STM characterization combined with theoretical calculations suggests that molecular free diffusion and structure matching between STs and Au play important roles in the construction of 2D crystal of STs.



(a) The ST unit consisting of three BPyB and one Fe atom. (b) STM image of a typical ST on Au(111). (c-e) Large-scale STM image of 2D crystals of STs. The coverage is 1, 0.65 and 0.57 monolayer, respectively (f-h) Close-up STM image of (c-e), respectively.

USM1600

Dilution-Refrigerator Based UHV/Ultra Low Temperature/High Magnetic Field STM System

Electron temperature ~110mK

Application fields: topological matters (Majorana), etc.

USM1600 Publication List in 2020 (Selected) 論文リスト

- "Robust Hot Electron and Multiple Topological Insulator States in PtBi," X. Nie et al., ACS Nano 14, 2366 (2020).
- "Localized Spin-Orbit Polaron in Magnetic Weyl Semimetal Co,Sn,S," Y. Xing et al., Nat. Commun. 11, 5613 (2020).

"A Tunable and Unidirectional One-Dimensional Electronic System Nb2014 Sin Te2014 Z. Zhu et al., npj Quantum. Mater. 5, 35 (2020).

JT-SPM

Joule-Thomson Ultra High Vacuum Very Low Temperature High Magnetic Field SPM System

Low temperature/high magnetic field SPM with optical access Technology taken over from SPECS. GmbH and improved and integrated with USM1200 series

Application fields: molecules, graphene, etc.

JT-SPM Publication List in 2020 (Selected) 論文リスト

- "Resolving Quinoid Structure in Poly-Para-Phenylene Chains" B. Yuan et al., J. Am. Chem. Soc. 142, 10034 (2020).
- "Precise Control of π-Electron Magnetism in Metal-Free Porphyrins" Y. Zhao et al., J. Am. Chem. Soc. 142, 18532 (2020).
- "Atomically Precise Synthesis and Characterization of Heptauthrene with Triplet Ground State" X. Su et al., ACS Nano 20, 6859 (2020).
- "Designer Spin Order in Diradical Nanographenes" Y. Zheng et al., Nat. Commun. 11, 6076 (2020).
- "Engineering of Magnetic Coupling in Nanographene"
- Y. Zheng et al., Phys. Rev. Lett. 124, 147206 (2020)

"Precise Control of π-Electron Magnetism in Metal-Free Porphyrins" Y. Zhao, K. Jiang *et al.*, J. Am. Chem. Soc. **43**, 18532 (2020). Product used: JT-SPM

Porphyrin is one of the most fundamental building blocks for functional molecular systems. The magnetism of localized spins in the center of the porphyrin has long been studied, but realizing delocalized spins in the porphyrin, which offer potentials for building correlated quantum spins, has remained elusive. Zhao et al. (Wang, Zhuang, Jia group, Shanghai Jiao Tong Univ.) revealed that metal-free porphyrins adsorbed on Au(111) host delocalized singlet π-electron spins using STM/AFM and theoretical calculations. The delocalized magnetism was precisely controlled by tailoring peripheral π-electron topology in



希釈冷凍方式超高真空超低温強磁場中走査型トンネル顕微鏡システム



ジュールトムソン方式超高真空極低温磁場中走査型プローブ顕微鏡システム



metal-free porphyrins and reversely switched on/off via STM manipulation by tuning the interfacial charge transfer between the porphyrin and Au substrate. Their study provides an effective way to engineer π-magnetism induced by porphyrins, implying potential applications for organic-molecules-based guantum information and spintronics.

Magnetism switching experiment by STM manipulation. (a-c) From left to right: chemical structure, nc-AFM image with a CO tip, constant-height STM image. (d) dl/dV spectra taken at the marked location in STM images.



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Ying-Shuang Fu

Huazhong University of Science and Technology, China

Research Interests

- Molecular beam epitaxy growth of low dimensional materials
- Electronic properties of topological states of matter
- Electronic properties of correlated states in low dimensional systems
- Spin-resolved spectroscopic imaging of magnetism in low dimensions





0.4K-12T STM





5K STM

Phason-Polaron Spectrum of Pure One-Dimensional Charge Density Wave in a Single Mo.Se. Nanowire



X. Yang, et al. Phys. Rev. X, **10**, 031061 (2020)

Electronic States of Bi Ultrathin Films Modulated by a NbSe₂ Substrate



L. Peng, et al., ACS Nano 13, 1885 (2019).





Topological Edge State Residing at Step Edge of WTe₂



L. Peng, et al., Nat. Commun. 8, 659 (2017).

Peter Liljeroth

Aalto University, Finland

Research Interests

- Low-temperature scanning tunneling microscopy and spectroscopy • Atomic force microscopy
- Two-dimensional materials. metal-organic frameworks
- On-surface synthesis
- Artificial lattices
- Designer quantum materials

Artificial Atomic Lattices

Examples of Artificial Lattices Constructed Using Chlorine Vacancies on Cu(100).





(a) STM topography, LDOS map and spatially resolved dl/dV spectroscopy on a dimer chain with two domain walls hosting topological mid-gap states. (b) STM topography (top) and the dispersive and flat band LDOS maps of a 1D cross chain. (c) Topography and LDOS maps of a Lieb lattice structure assembled from CI vacancies.

Topological States in Engineered Atomic Lattices, R. Drost et al. Nat. Phys. 13, 668 (2017). Tuneable Topological Domain Wall States in Engineered Atomic Chains, Md N. Huda et al. npj Quant. Mater. 5, 17 (2020). Designer Flat Bands in Quasi-One-Dimensional Atomic Lattices, Md N. Huda et al. Phys. Rev. Res. 2, 043426 (2020).

Yu-Shiba-Rusinov States and Spin-Flip Excitations in Molecular Systems





Topological Superconductivity in Van Der Waals Heterostructures

Topological Superconductivity in CrBr₃-NbSe₂ Heterostructures.

(a) Schematic of the heterostructure. (b) STM topography and dI/dVspectroscopy showing the presence of edge modes at the edges of the CrBr₃ monolayer. (c) Spatially resolved spectroscopy and LDOS maps of the Maiorana zero modes.

Topological Superconductivity in a Van Der Waals Heterostructure, S. Kezilebieke et al. Nature 588, 424 (2020). Moiré-Enabled Topological Superconductivity, S. Kezilebieke et al. arXiv:2011.09760

(a),(b) STM topography and *dl/dV* spectroscopy of MnPc and CoPc molecules. (c) Tunneling conductance as a function of the exchange coupling pJ showing the co-existence of YSR states and spin-flip excitations

Coupled Yu-Shiba-Rusinov States in Molecular Dimers on NbSe. S. Kezilebieke et al. Nano Lett. 18, 2311 (2018). Observation of Coexistence of YSR States and Spin-Flip Excitations, S. Kezilebieke et al. Nano Lett. 19, 4614 (2019).

Toru Hirahara

Tokyo Institute of Technology, Japan

Research Interests

- Novel atomically thin 2D systems
- High-temperature superconductivity: FeSe/STO
- Magnetic topological insulators



Interfacial Superconductivity in FeSe Ultrathin Films on SrTiO₃ Probed by In Situ Independently **Driven Four-Point-Probe Measurements** A. Pedersen et al., Phys. Rev. Lett. 124, 227002 (2020).



Photograph of the USM1400 system





(a) Photograph of the four probes. (b) Probe spacing dependence measurements to determine the conductivity dimension.

(c) Temperature dependence of the measured resistance for films with different thicknesses.

(d) Same as (c) but shown in normalized resistance to show the universal feature of the superconductivity onset at 40 K.

Superconductivity of Single Unit Cell FeSe/SrTiO₃(001): Substrate-Surface Superstructure Dependence T. Tanaka et al., Phys. Rev. B 98, 121410(R) (2018).

Superconducting Dome Revealed by Surface Structure Dependence in Single Unit Cell FeSe on SrTiO₃(001) T. Tanaka et al., Phys. Rev. B 101, 205421 (2020).



(a)-(d) Atomically resolved image of the 1UC FeSe grown on different STO surface superstructures. (e): dl/dV spectra taken on the 1UC FeSe grown on different STO surface superstructures. (f) Same as (e) but those obtained near the Fermi level showing the superconducting gap.

Yi Du

Australian Institute for Innovative Materials (AIIM) The University of Wollongong, Australia

Research Interests

- Scanning tunneling microscopy
- · 2D Xenes materials (silicene, germanene, stanene and blue phosphorene) and 2D frustrated lattice systems
- MBE growth of 2D device structures (photodetectors,
- sodium ion batteries, etc.)



Realization of Flat Band with Possible Nontrivial Topology in Electronic Kagome Lattice



Z. Li et al., Sci. Adv. 4, eaau4511 (2018).

Experimental Realization of Two-Dimensional Buckled Lieb Lattice

Flat band



H. Feng, et al., Nano Lett. 20, 2537 (2020).

Realization of Strained Stanene by Interface Engineering



Y.Liu et al., J. Phys. Chem. Lett. 10, 7, 1558 (2019).

and measurement chambers





(a) STM image of the Kagome lattice on a twisted multilayered silicene on the Ag(111) substrate. (b,c) STS image simultaneously obtained with (a) at the flat-band energy, showing the Kagome pattern and at the edge state energy, respectively.

> (a) Atomic resolution STM image of 0.5 ML Sn on Al(100).

(b) Model structure of buckled Lieb lattice comprising Sn in a $\sqrt{2} \times \sqrt{2}$ superstructure and the topmost AI atoms of the AI(100) substrate.

(c) 3D band structure of the buckled Lieb lattice, possessing a broken nodal line loop.

Raman shift (cm⁻¹)

(a) STM image of 1 ML Sn-deposited surface on the Au(111) substrate, showing a $\sqrt{3} \times \sqrt{7}$ superstructure.

(b,c) dl/dV spectra and in-situ Raman spectra for the 2 ×2, $\sqrt{3}$ × $\sqrt{3}$, and $\sqrt{3}$ × $\sqrt{7}$ phases, respectively.

B Beer in Bsaka 電子 大阪のビール *Newsletter編集部調べ



<History>

<Statistics>

Shozaburo Shibutani founded Shibutani Beer, the 1st beer brewery by Japanese, in 1872. Komakichi Torii founded Osaka beer (currently ASAHI BREWERIES, LTD.) in 1889. SUNTORY started beer business in 1963. 渋谷庄三郎が日本最初のビール醸造所設立「渋谷ビール」販売(1872年) 島井駒吉大阪麦酒(現アサヒ)創業 サントリーは1963年にビール事業を開始しました。

The place where the first Japanese beer was brewed in Dojima 国産ビール発祥の地碑

Production of beer in Osaka is 2nd largest in Japan. Beer consumption per person in Osaka is 2nd largest in Japan. 大阪のビールの生産量は国内2位、ビールー人当たり消費量2位

Dotal Beer Report @ D 現地に行って来ました!

Minoh Beer ・箕面ビール Production is 5th largest in Japan. 出荷量は全国5位







大阪のビールとワインを飲み比べてみました。

Minoh Beer・箕面ビール

Weizen・ヴァイツェン



さわやかさ Light ★★★★★ -ツ感 Fruity flavor ★★★ 苦味 Bitterness ★ ABV.5.0%, IBU:12





Stout・スタウト



コク Body ★★★ 焙煎香 Roasted flavor ★★★★ 苦味 Bitterness ★★ ABV.5.5%, IBU:32





Imperial Stout・インペリアルスタウト



17

コク Body ★★★★ 焙煎香 Roasted flavor ★★★★ 甘味 Sweetness ★★ 苦味 Bitterness ★★★ ABV.8.5%, IBU:60



Kura Amber・蔵アンバー

飲みやすさ Drinkability ★★★★ コク Body★★ 焙煎香 Roasted flavor ★★★ 麦芽感 Moltiness ★★★ ABV.5.0%, IBU:20

Kijo Gold・貴醸ゴールド

飲みやすさ Drinkability ★★★ さわやかさ Light ★★ 日本酒風味 Sake flavor ★★★ 甘味 Sweetness ★★★★ ABV.5.0%, IBU:20

<番外>ユニソクの地元枚方発ビール Hirakata Beer・枚方ビール



Hirakata Ale·HIRAKATAI-JV

飲みやすさ Drinkability ★★ 飲みごたえ Body ★★ ホップ感 Hoppy flavor ★★★ 苦味 Bitterness ★★★ ABV.5.0%, IBU:40

in Osaka 地ビール& ワイナリーマップ

UNISOK

0

Well balanced

wine!

Wait,

is it coffee?

Easy to drink.

e typical impressio

the dry white win

is overturned.

A Beer from

B味道像

柠檬。吃

烤肉的时

候喝是很

不错的。

Hirakata could be popular worldwide



0

4

0

MARCA BREWING

・MARCAブルーイング

Hazy IPA・ヘイジーIPA

Grape Sour・グレープサワー

6



Introduction of Katashi grapes village 堅下村葡萄の歴史パネル

Katashimo Winery @ カタシモワイナリー

Gomeiyama Merlot ・合名山メルロ(赤辛口)

バランス Balance★★★★ フルーティ Fruity flavor★★★ ボディ(味の濃さ) Body★★★ (Medium body) **樽香 Barrel incense★★★** ABV.13.0%

Kawachi Winery D 河内ワイン

Kintoku Wine Niagara ・金徳葡萄酒ナイアガラ(白辛口)

マスカット香 Muscatel flavor★★★★ 辛口 Dry taste★★★★ 酸味 Sour★★ さわやかさ、新鮮味 Freshness★★★★ ABV.12.0%

Osaka Local Craft Beer ・大阪府内クラフトビール Minoh city, Osaka 大阪府箕面市

- Minoh Beer 箕面ビール
- **3TREE BREWERY**
- Kamigata Beer 上方麦酒
 - Brewpub CenterPoint
 - O Brewpub Têtard Vallée
 - **7** BAK BEER Botombori Beer 道頓堀地ビール
 - Oerailleur Brew Works
 - 10 MARCA BREWING
- ONE's BREWERY

1 BEER BELLY

- 12 Arimoto Beer 有本麦酒
- 飲みやすさ Drinkability ★★★★★ フルーティ Fruity flavor ★★★★★ 辛口 Dry taste ★★
 - 苦味 Bitterness Zero ABV.5.0%, IBU:10

Coffee Amber・コーヒーアンバー ()

- 飲みやすさ Drinkability ★★★ コク Body ★★★ -感 Coffee flavor ★★★★★
 - ABV.4.5%, IBU:10

飲みやすさ Drinkability ★★★★ 酸味 Sour ★★★★ 7ルーティ Fruity flavor ★★★★ 苦味 Bitterness Zero ABV.5.0%, IBU:10 Lemon Weizen・レモンヴァイツェン B

飲みやすさ Drinkability ★★★

ホップ感 Hoppy flavor ★★★★

苦味 Bitterness ★★★

コク Body ★★★

ABV.7.0%, IBU:35













- 甘味 Sweet ★

Kuninocho Beer ・國乃長ビール 大阪最初のクラフトビール The oldest craft beer in Osaka

Tasting Report A att att ユニソク社員有志数名にて勤務後に試飲会を開催。



<History>

The grapes recently produced in Osaka originate from the transplant of Koshu grapes from Osaka nursery garden to Kashiwara city in 1878. Since then, the grape production was expanded to wide areas in the southern part of Osaka during the Meiji and Taisho Eras and thus has a long history of more than 100 years.

近代の大阪府内で栽培されている葡萄は、明治11年(1878年)頃、当時の大阪府育苗 園から柏原市に甲州葡萄の苗が移植されたのをきつかけに明治、大正期に中河内 南河内地域に広がり、現在にわたって栽培されており、100年以上の古い歴史がある。 <Statistics>

Wine production in Osaka used to be No. 1 in Japan. Wine consumption per person is 5th largest in Japan. (As of 2018) 大阪のワインは1928~1938年の16年間、日本一の生産量 ワインの一人当たりの消費量5位(2018年現在)



The oldest winery in West Japan, founded by Sakujiro Takai in 1914 The wine was served at G20 Osaka Summit 2019. 高井作次郎創業(西日本最古) 2019年G20大阪サミットで提供

Kawachi Winery・河内ワイン館





Farm/factory tours and tastings are held regularly 定期的に農園・工場見学・試飲会が行われている

Osaka Kuninocho Beer 大阪國乃長ビール

Ichioka brewerv 市岡ビール工房 地底旅行

13 Tempozan Beer 天保山ビール

10 Nakatsu brewery n Sakai Shukaku Beer 堺収穫麦酒 18 KIX BEER KIX BEER 泉佐野ブルーイング

Osaka Local Winery・大阪府内ワイナリー

① Katashimo Winery カタシモワイナリー **2 Fujimaru** 島之内フジマル醸造所 **3** Asuka Wine 飛鳥ワイン 4 Kawachi Wine (株)河内ワイン **5** Nakamura Wine 仲村わいん工房 **6** Hirakata sugi Ricoro farm 枚方杉リコロファーム

Takatsuki city, Osaka 大阪府高槻市 Ibaraki city, Osaka 大阪府茨木市 Higashiyodogawa ward, Osaka city 大阪府大阪市東淀川区 Kita ward, Osaka city 大阪府大阪市北区 Chuo ward, Osaka city 大阪府大阪市中央区 Chuo ward, Osaka city 大阪府大阪市中央区 Chuo ward, Osaka city 大阪府大阪市中央区 Nishinari ward, Osaka city 大阪府大阪市西成区 Nishi ward, Osaka city 大阪府大阪市西区 Nishi ward, Osaka city 大阪府大阪市西区 Ikuno ward, Osaka city 大阪府大阪市生野区 Minato ward, Osaka city 大阪府大阪市港区 Nishi ward, Osaka city 大阪府大阪市西区 Minato ward, Osaka city 大阪府大阪市港区 Kita ward, Osaka city 大阪府大阪市北区 Sakai city, Osaka 大阪府堺市 Izumisano city, Osaka 大阪府泉佐野市

> Kashiwara city, Osaka 大阪府柏原市 Chuo ward, Osaka city 大阪府大阪市中央区 Habikino-city, Osaka 大阪府羽曳野市 Habikino-city, Osaka 大阪府羽曳野市 Habikino-city, Osaka 大阪府羽曳野市 Hirakata-city, Osaka 大阪府枚方市

