

Integrated Research Center for Carbon Negative Science

T. Nohira, Professor
 K. Kondo, Program-Specific Associate Professor
 S. Chuaychob, Program-Specific Assistant Professor
 A. Yadav, Program-Specific Assistant Professor

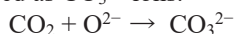
1. Introduction

In order to achieve carbon neutrality by 2050, we need to develop new energy systems that include active carbon dioxide fixation processes in addition to "zero-emission" technologies. Our research center is conducting research on such carbon negative technologies. To be specific, we are working on the conversion of carbon dioxide into useful materials by using renewable energy and biomass, etc.

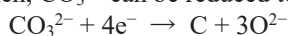
In this fiscal year, we have investigated the conversion of CO₂ into carbon material by molten salt electrochemical process. We have also studied CO₂ fixation reaction which is facilitated by an enzyme called ribulose 1,5-bisphosphate carboxylase/oxygenase (RuBisCO).

2. Conversion of CO₂ into Carbon Material by Molten Salt Electrochemical Process

As one of the Carbon dioxide Capture and Utilization (CCU) technologies, the electrochemical synthesis of carbon in molten salts is attracting much attention [1]. By using molten salts containing O²⁻ ions, CO₂ can be captured as CO₃²⁻ ions.



Then, CO₃²⁻ can be reduced to carbon as follows.



Many allotropes of carbon, for example, diamond [2], amorphous carbon, graphite, carbon nanotubes, and carbon nanofibers have been electrodeposited in molten salt. In this fiscal year, the electrodeposition of carbon from molten LiCl–KCl–K₂CO₃ was conducted at various potentials (0.6–1.0 V vs. Li⁺/Li) and temperatures (773–973 K) to investigate the effect of electrolysis conditions on carbon deposition.

Fig. 1 shows the transitions of current density during electrolysis. The current density increased as the potential became negative. The photograph of a typical sample on a Ni substrate is shown in Fig. 2. The black deposits were attached to the substrate and the black powders were obtained after washing. Fig. 3 shows the Raman spectrum of the sample obtained at 0.80 V. Broad bands attributed to the D-band (around 1350 cm⁻¹) and G-band (around 1570 cm⁻¹) are observed. These spectra are specific to amorphous carbon, which has both sp² and sp³ hybrid orbital. There is no significant difference in the electrodeposited carbon at the different potentials and temperatures.

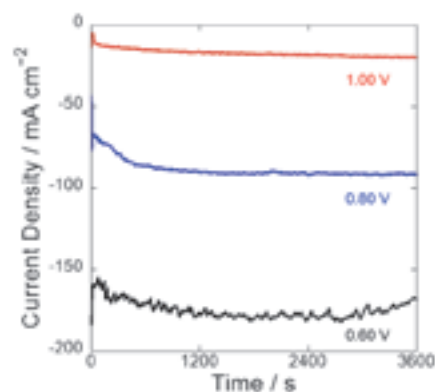


Fig. 1. Transitions of current density during the electrolysis at 0.60 V, 0.80 V, and 1.00 V in molten LiCl–KCl–K₂CO₃ at 973 K.

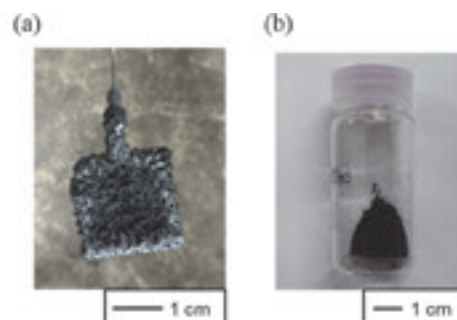


Fig. 2. Photographs of the sample electrodeposited by potentiostatic electrolysis at 0.6 V for 30 min at 873 K in molten LiCl–KCl–K₂CO₃. (a) As electrodeposited, (b) after washed.

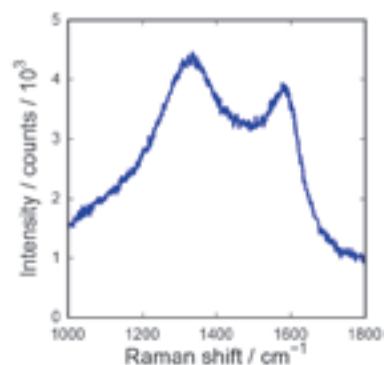


Fig. 3. Raman spectra of carbon electrodeposited at 0.80 V in molten LiCl–KCl–K₂CO₃ at 973 K.

Table 1 Current efficiencies in the electrodeposition of carbon in molten LiCl–KCl–K₂CO₃ at various electrolysis conditions.

	0.4 V	0.6 V	0.8 V
773 K	97%	94%	98%
873 K	89%	93%	91%
973 K	61%	71%	72%

Table 1 summarizes the current efficiencies of carbon deposition under various potentials and temperatures. High current efficiencies of 89–98% were achieved at 773 and 873 K. On the other hand, the current efficiencies tended to decrease at 973 K. This may be because, at 973 K, the current used for carbon monoxide generation instead of carbon deposition increased.

3. Novel Process for Carbon Fixation Reaction

RuBisCO enzyme, the most abundant enzyme on earth, catalyzes the primary CO₂ fixation reaction in plants, algae, and bacteria via the Calvin–Benson–Bassham (CBB) pathway. This enzyme catalyzes two competing reactions: (1) carboxylase reaction producing 3-phosphoglycerate (3-PGA) from ribulose 1,5-bisphosphate (RuBP), CO₂, and H₂O, and (2) oxygenase reaction adding O₂ to RuBP, resulting in 3-PGA and 2-phosphoglycolate. The oxygenase reaction reduces photosynthesis efficiency. Furthermore, RuBisCO is an enzyme that has low turnover efficiency.

As one of RuBisCOs, *T. kodakaraensis* KOD1, or *Tk*-RuBisCO enzyme shows extreme thermostability, high carboxylase activity, and specificity at a high-temperature range. This suggests that the enzyme's stable protein scaffold can tolerate higher degrees of mutations at ambient temperatures compared to other types. These outstanding properties make *Tk*-RuBisCO an attractive target for structure-function studies and protein engineering to improve CO₂ fixation activity.

By using the recombinant *Tk*-RuBisCO, an initial examination as to whether a *Tk*-RuBisCO could extend the substrate rather than RuBP. A *Tk*-RuBisCO was expressed in *E. coli* and used for CO₂ fixation activity after purification (Fig. 4). Activity was investigated and confirmed with two different substrates such as RuBP and ribulose 5-phosphate (Ru5P) via the NADH-linked spectrophotometric assays using GAPDH coupling enzymes for measuring RuBisCO activity.

Fig. 5 shows the enzymatic activities of *Tk*-RuBisCO that 3-PGA was produced. Along with the native RuBP substrate, significant levels of CO₂ fixation activity were observed as a result of the increase in 3-PGA production (Fig. 5a). On the other hand, the 3-PGA production detected from an alternative Ru5P substrate (Fig. 5b) was lower than that of the native substrate one. That could be a lack of affinity for Ru5P compared to RuBP. Thus, the

activity could be observed only at a high concentration of Ru5P.

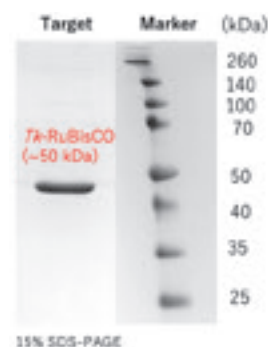


Fig. 4. SDS-PAGE analysis of *Tk*-RuBisCO.

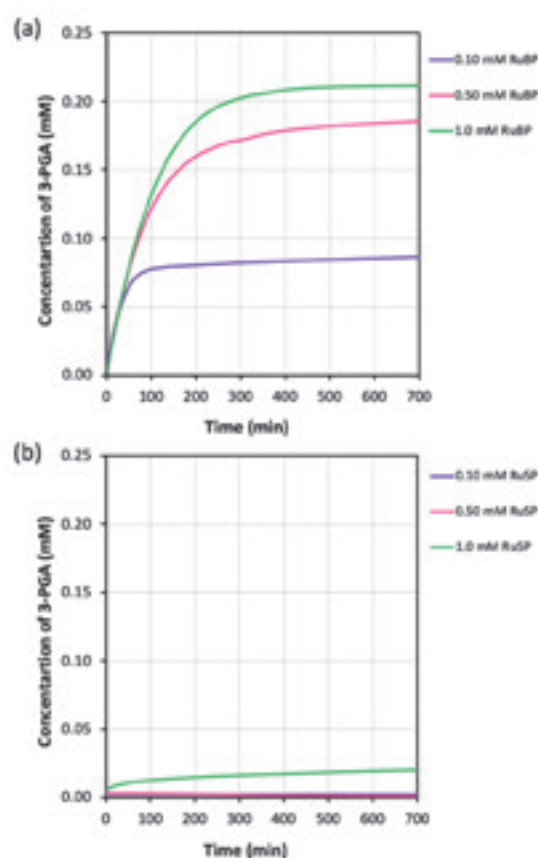


Fig. 5. The production of 3-PGA from CO₂ fixation reaction is catalysed by *Tk*-RuBisCO using native RuBP (a) and alternative Ru5P (b) substrates.

Acknowledgment

A part of this study was conducted in collaboration with Cosmo Oil Co., Ltd.

References

- [1] F. Zhu, J. Ge, Y. Gao, S. Li, Y. Chen, J. Tu, M. Wang, and S. Jiao, *Explor.*, **3**, 20210186 (2023).
- [2] Y. Norikawa, Y. Horiba, K. Yasuda, and T. Nohira, *J. Electrochem. Soc.*, **170**, 052507 (2023).

Collaboration Works

野平俊之, コスモ石油-京都大学, 「熔融塩電解による CO₂ の炭素固定化技術」に関する研究

Financial Support

1. Grant-in-Aid for Scientific Research

野平俊之, 基盤研究(A), 液体亜鉛陰極を利用した太陽電池用シリコンの新製造法

近藤敬子, 基盤研究(C), 木質の多糖分解およびリグニン分解に関わる酸化還元酵素間の協奏効果の解析

近藤敬子, 基盤研究(C), リグニンと多糖を分離する酵素の実バイオマスに対する活性および構造機能相関の解析

2. Others

野平俊之, 科学技術振興機構, ハイドレートメルト電解液を利用した革新的・高効率グリーン水素製造法

野平俊之, 新エネルギー・産業技術総合開発機構, 部素材からのレアアース分離精製技術開発事業

野平俊之, アイ・エムセップ(株), 熔融塩を用いた二酸化炭素の資源化に関する研究奨学のため

野平俊之, コスモ石油(株)(OI 機構), 「熔融塩を用いた電解による CO₂ の有価物への固定化技術」に関する研究

野平俊之, 三谷化工(株), バイオマス・エネルギー利用の共同研究

野平俊之, 三菱マテリアル(株), 熔融塩電解による電池向け高機能カーボン材の合成

野平俊之, 日本タングステン(株), 金属基板及び金属ワイヤー表面へのタングステン電析に関する研究

Publications

Y. Norikawa, Y. Horiba, K. Yasuda, T. Nohira, Electrochemical Synthesis of Diamond in Molten LiCl–KCl–K₂CO₃–KOH, *Journal of The Electrochemical Society*, 170, 5, 052507, 2023

W. Moteki, Y. Norikawa, T. Nohira, Electrodeposition of Crystalline Si Using a Liquid Zn Electrode in Molten KF–KCl–K₂SiF₆, *Journal of The Electrochemical Society*, 170, 062506, 2023

T. Nishida, Y. Fukunaka, T. Homma, T. Nohira, Potentiostatic Li Electrodeposition in LiTFSI-PC Electrolyte, *Journal of Physical Chemistry C*, 127, 26, 12454-12465, 2023

K. Kawaguchi, K. Goto, A. Konno, T. Nohira, Novel High-Temperature Alkaline Water Electrolysis Using Molten KOH–H₂O System, *Journal of The Electrochemical Society*, 170, 084507, 2023

A. Yadav, H. Kobayashi, T. Nikaido, T. Yamamoto, T. Nohira, Potassium-based dual-carbon battery with pure ionic liquid electrolyte, *Journal of Power Sources*, 585, 233628, 2023

K. Kawaguchi, T. Nohira, Electrochemical Formation of Dy–Fe Alloys in Molten LiF–CaF₂–DyF₃, *Journal of The Electrochemical Society*, 170, 10, 102504, 2023

Y. Domi, H. Usui, K. Kuritani, N. Wada, K. Nishikawa, T. Yamamoto, T. Nohira, H. Sakaguchi, Anode Properties of Sb-Based Alloy Electrodes for K-Ion Batteries in an Ionic-Liquid Electrolyte, *ACS Applied Energy Materials*, 6, 22, 11583-11591, 2023

M. Sepúlveda, H. Sopha, Y. Norikawa, L. Hromadko, J. Rodriguez-Pereira, O. Man, T. Nohira, K. Yasuda, J. M. Macak, Can electrodeposited Ti replace rolled Ti as substrate for the growth of anodic TiO₂ nanotube layers?, *Electrochimica Acta*, 479, 143877, 2024

Y. Norikawa, T. Nohira, A New Concept of Molten Salt Systems for the Electrodeposition of Si, Ti, and W, *Accounts of Chemical Research*, 56, 13, 1698-1709, 2023

T. Yamamoto, T. Nohira, Amide-based ionic liquid electrolytes for alkali-metal-ion rechargeable batteries, *Chemical Record*, 23, 8, e202300169, 2023

O. Eladl, Y. Yamaoki, K. Kondo, T. Nagata, M. Katahira, Complex formation of an RNA aptamer with a part of HIV-1 Tat through induction of base triples in living human cells proved by in-cell NMR, *International Journal of Molecular Sciences*, 24, 10, 9069, 2023

K.S.K. Teo, K. Kondo, K. Saito, Y. Iseki, T. Watanabe, T. Nagata, M. Katahira, Enhanced depolymerization of beech wood lignin and its removal with peroxidases through continuous separation of lignin fragments, *Green Chemistry*, 25, 19, 7682-7695, 2023

H. Morita, S. Chida, M. Takato, K. Kondo, M. Katahira, L.B. Simao, M. Takeda, Enzymatic degradation of glucosaminoglucan and cellulase resistance of cellulose nanofiber coated with glucosaminoglucan, *Journal of Applied Microbiology*, 134, 9, 1xad199, 2023

A. Phienluphon, K. Kondo, B. Mikami, T. Nagata, M. Katahira, Structural insights into the molecular mechanisms of substrate recognition and hydrolysis by feruloyl esterase from *Aspergillus sydowii*, *International Journal of Biological Macromolecules*, 253, 5, 127188, 2023

A. Eladl, Y. Yamaoki, K. Kamba, S. Hoshina, H. Horinouchi, K. Kondo, S. Waga, T. Nagata, M. Katahira, NMR characterization of the structure of the intrinsically disordered region of human origin recognition complex subunit 1, hORC1, and its interaction with G-quadruplex DNAs, *Biochemical and Biophysical Research Communications*, 683, 149112, 2023

K.S.K. Teo, K. Kondo, T. Watanabe, T. Nagata, M. Katahira, Understanding manganese peroxidase-catalyzed conversion of the lignin structure and its application for the polymerization of Kraft lignin, *ACS Sustainable Chemistry & Engineering*, 12, 6, 2172-2182, 2024

K.S.K. Teo, K. Kondo, S. Khattab, T. Watanabe, T. Nagata, M. Katahira, Enhancing bioethanol production from rice straw through environmentally-friendly delignification using versatile peroxidase, *Journal of Agricultural and Food Chemistry*, 2024

A. Phienluphon, K. Kondo, H. Okano, T. Watanabe, T. Nagata, M. Katahira, Boosting Sugarcane Trash Decomposition: Synergistic action and proximity effect of Xylanase and Feruloyl Esterase co-displayed on the cell surface of *Pichia pastoris* (*Komagataella phaffii*), *Sustainable Energy & Fuels*, 2024

A. Phienluphon, K. Kondo, B. Mikami, S.K.K. Teo, K. Saito, T. Watanabe, T. Nagata, M. Katahira, Structure-based characterization and improvement of an enzymatic activity of *Acremonium alcalophilum* feruloyl esterase, *ACS Sustainable Chemistry & Engineering*, 2023

N. Kobayashi, T. Hashizume, K. Kondo, K. Kitayama, M. Katahira, T. Watanabe, Reassembly of wood to plastic-and paper-like films via ultra-mild dissolution in formic acid, *Materials Advances*, 2024

Presentations

和田直也, 道見康弘, 薄井洋行, 山本貴之, 野平俊之, 坂口裕樹, 希土類アンチモナイドを用いたカリウムイオン電池用負極の創製, 第 39 回希土類討論会, 札幌コンベンションセンター, 2023.5.30-31

T. Nohira, Y. Norikawa, Y. Horiba, R. Matsuyama, Electrochemical Synthesis of Diamond from Carbon Dioxide in Molten Lithium Chloride-Potassium Chloride Systems, 243rd ECS Meeting, Hynes Convention Center, 2023.5.28-6.2

Y. Norikawa, M. Unoki, T. Nohira, Electrodeposition of Ti in Molten Alkali Metal Fluoride-Chloride Mixtures: Comparative Study of Li, Na, K, and Cs Systems, 243rd ECS Meeting, Hynes Convention Center, 2023.5.28-6.2

山本貴之, 焦楷, 木内久雄, 趙昊懂, 野平俊之, カリウム二次電池用鉄系正極材料の充放電反応メカニズム解析, 2023 年度 SR センター研究成果報告会, 立命館大学びわこ・くさつキャンパス, 2023.6.17

山本貴之, イオン液体電解質を用いた新規二次電池の開発, 第 95 回マテリアルズ・テラリング研究会, 軽井沢研修所, 2023.8.3-5

焦楷, 山本貴之, 木内久雄, 趙昊懂, 野平俊之, カリウムイオン電池用鉄系正極材料の充放電特性, 第 95 回マテリアルズ・テラリング研究会, 軽井沢研修所, 2023.8.3-5

茂木渉, 法川勇太郎, 野平俊之, 薄膜型液体 Zn 電極を用いた熔融 KF-KCl-K₂SiF₆ 中における結晶性 Si 膜電析, 第 95 回マテリアルズ・テラリング研究会, 軽井沢研修所, 2023.8.3-5

後藤啓太, 川口健次, 野平俊之, 熔融 KOH-H₂O 系を用いた新規高温アルカリ水電解, 第 95 回マテリアルズ・テラリング研究会, 軽井沢研修所, 2023.8.3-5

H. Wang, Y. Norikawa, T. Nohira, Effect of O²⁻ Ion on W Film Electrodeposition in Molten CsF-CsCl, 第 95 回マテリアルズ・テラリング研究会, 軽井沢研修所, 2023.8.3-5

侯正陽, 法川勇太郎, 野平俊之, 熔融 KF-KCl 中における二段階 Si 膜電析による p-n 接合の作製, 第 95 回マテリアルズ・テラリング研究会, 軽井沢研修所, 2023.8.3-5

Y. Yamasaki, Y. Domi, H. Usui, T. Yamamoto, T. Nohira, H. Sakaguchi, Effect of Difference in Charge Carriers on Charge-Discharge Properties of Bi-Sb Alloy Electrodes, The 14th International Symposium of Advanced Energy Science, Uji Campus, Kyoto University, 2023.8.30-31

A. Teramae, H. Usui, Y. Domi, T. Yamamoto, T. Nohira, K. Matsumoto, R. Hagiwara, H. Sakaguchi, $\text{CeO}_2/\text{Sb}_2\text{O}_3$ Composite Anodes for Na-Ion Batteries, The 14th International Symposium of Advanced Energy Science, Uji Campus, Kyoto University, 2023.8.30-31

W. Moteki, Y. Norikawa, T. Nohira, Electrodeposition of Crystalline Si Film in Molten $\text{KF-KCl-K}_2\text{SiF}_6$ Using Thin Liquid Zn, The 14th International Symposium of Advanced Energy Science, Uji Campus, Kyoto University, 2023.8.30-31

Z. Hou, W. Moteki, Y. Norikawa, T. Nohira, Preparation of p-n Junction Si Films by Si Electrodeposition in Molten KF-KCl , The 14th International Symposium of Advanced Energy Science, Uji Campus, Kyoto University, 2023.8.30-31

H. Wang, Y. Norikawa, T. Nohira, Effect of O^{2-} Ion Concentration on Electrodeposition of W Films in Molten CsF-CsCl , The 14th International Symposium of Advanced Energy Science, Uji Campus, Kyoto University, 2023.8.30-31

Y. Katasho, Y. Norikawa, T. Oishi, T. Nohira, Raman Spectroscopy of Molten Salts Containing Boron Ions, The 14th International Symposium of Advanced Energy Science, Uji Campus, Kyoto University, 2023.8.30-31

T. Nohira, Electrochemical reduction of CO_2 to carbon materials in molten salts, The 14th International Symposium of Advanced Energy Science, 京都大学宇治キャンパス, 2023.9.1

安田幸司, H. Sopha, 法川勇太郎, M. Motola, L. Hromadko, J. Rodriguez-Pereira, Jiri Cerny, 野平俊之, 熔融塩中で電析した金属チタン膜のアノード酸化による TiO_2 ナノチューブの形成, 表面技術協会第148回講演大会, 山形大学 米沢キャンパス, 2023.9.4-5

川口健次, 野平俊之, 熔融塩電解と合金隔膜を利用した廃ネオジム磁石からの希土類元素の分離・回収に関する研究, シンポジウム「リサイクル設計と分離精製技術」第41回: 希土類元素分離精製技術開発の最前線, オンライン, 2023.11.7

W. Moteki, Y. Norikawa, T. Nohira, Electrodeposition of Crystalline Si Film Using Thin Liquid Zn in Molten $\text{KF-KCl-K}_2\text{SiF}_6$, 3rd Nucleation and Growth Research Conference, Nippon Christian Academy Kansai Seminar House, 2023.11.9-11

Z. Hou, Y. Norikawa, T. Nohira, Preparation of p-n Junction Si Films by Si Electrodeposition in KF-KCl Molten Salt, 3rd Nucleation and Growth Research Conference, Nippon Christian Academy Kansai Seminar House, 2023.11.9-11

H. Wang, Y. Norikawa, T. Nohira, Effect of O^{2-} Ion Concentration on the Crystalline Structure of Electrodeposited W Films in Molten CsF-CsCl , 3rd Nucleation and Growth Research Conference, Nippon Christian Academy Kansai Seminar House, 2023.11.9-11

K. Goto, K. Kawaguchi, T. Nohira, Novel Highly Efficient Water Electrolysis Using NaOH-KOH Hydrate Melt, 3rd Nucleation and Growth Research Conference, Nippon Christian Academy Kansai Seminar House, 2023.11.9-11

Y. Ishio, T. Yamamoto, T. Nohira, In-situ Raman spectroscopic analysis of the electrode/electrolyte interface in the sodium secondary battery utilizing FSA-based ionic liquids, 2023 Joint Symposium on Molten Salts (MS12), Kyoto Garden Palace, 2023.11.12-16

K. Jiao, T. Yamamoto, T. Nohira, Charge-discharge behavior of $\text{K}_0.45\text{MnO}_2$ positive electrode for K-ion battery using an FSA-based ionic liquid electrolyte, 2023 Joint Symposium on Molten Salts (MS12), Kyoto Garden Palace, 2023.11.12-16

R. Oe, T. Yamamoto, T. Nohira, Charge-Discharge Behavior of Graphite Positive Electrode in FSA-Based Ionic Liquid Electrolytes, 2023 Joint Symposium on Molten Salts (MS12), Kyoto Garden Palace, 2023.11.12-16

W. Moteki, Y. Norikawa, T. Nohira, Electrodeposition of Crystalline Si Film Using Liquid Zn Electrode in Molten $\text{KF-KCl-K}_2\text{SiF}_6$, 2023 Joint Symposium on Molten Salts (MS12), Kyoto Garden Palace, 2023.11.12-16

Z. Hou, Y. Norikawa, T. Nohira, Preparation of PN Junction by Two-step Si Electrodeposition in Molten KF-KCl , 2023 Joint Symposium on Molten Salts (MS12), Kyoto Garden Palace, 2023.11.12-16

H. Wang, Y. Norikawa, T. Nohira, Effect of O^{2-} Ion Concentration on the Crystal Structure of Electrodeposited W Films in Molten CsF–CsCl, 2023 Joint Symposium on Molten Salts (MS12), Kyoto Garden Palace, 2023.11.12-16

K. Goto, K. Kawaguchi, T. Nohira, High-Temperature Water Electrolysis Using Molten NaOH–KOH–H₂O System, 2023 Joint Symposium on Molten Salts (MS12), Kyoto Garden Palace, 2023.11.12-16

Y. Sakai, Y. Norikawa, T. Nohira, Potential Dependence of Carbon Electrodeposition in Molten LiCl–KCl–K₂CO₃, 2023 Joint Symposium on Molten Salts (MS12), Kyoto Garden Palace, 2023.11.12-16

山本貴之, 大江理久, 石尾吉史, ヤダヴ アリシャ, 野平俊之, アミド系イオン液体電解質中におけるグラファイト正極の充放電挙動, 第 13 回イオン液体討論会, 朱鷺メッセ, 2023.11.21-22

焦楷, 山本貴之, 木内久雄, 趙昊懂, 野平俊之, FSA 系イオン液体を用いたカリウム二次電池における遷移金属酸化物正極の充放電特性, 第 13 回イオン液体討論会, 朱鷺メッセ, 2023.11.21-22

川口健次, 後藤啓太, 野平俊之, NaOH–KOH 系ハイドレートメルトを用いた新規高効率水電解, 第 47 回電解技術討論会, 大阪公立大学 I-site なんば, 2023.11.21-22

大江理久, 石尾吉史, 山本貴之, 野平俊之, Na[FSA]–[C3Clpyrr][FSA]イオン液体中におけるグラファイト正極の充放電挙動, 第 64 回電池討論会, 大阪府立国際会議場, 2023.11.28-30

和田直也, 道見康弘, 薄井洋行, 山本貴之, 野平俊之, 坂口裕樹, 希土類アンチモナイドとアンチモンからなるコンポジット電極のカリウムイオン電池負極特性, 第 64 回電池討論会, 大阪府立国際会議場, 2023.11.28-30

石尾吉史, 山本貴之, 野平俊之, その場ラマン分光分析を用いたナトリウム二次電池におけるレート特性向上要因の解析, 2023 年度第 3 回関西電気化学研究会, 神戸大学百年記念館六甲ホール, 2023.12.9

後藤啓太, 川口健次, 野平俊之, NaOH–KOH 系ハイドレートメルトを用いた新規高効率水電解, 2023 年度第 3 回関西電気化学研究会, 神戸大学百年記念館六甲ホール, 2023.12.9

H. Wang, Y. Norikawa, T. Nohira, Effect of O^{2-} Ion on W Electrodeposition in Molten CsF–CsCl, 2023 年度第 3 回関西電気化学研究会, 神戸大学百年記念館六甲ホール, 2023.12.9

侯正陽, 茂木渉, 法川勇太郎, 野平俊之, KF–KCl 熔融塩を用いた二段階 Si 膜電析による p–n 接合の作製, 2023 年度第 3 回関西電気化学研究会, 神戸大学百年記念館六甲ホール, 2023.12.9

大江理久, 石尾吉史, 山本貴之, 野平俊之, FSA 系イオン液体電解質中のカチオン種がグラファイト正極挙動に与える影響, 電気化学会第 91 回大会, 名古屋大学東山キャンパス, 2024.3.14-16

茂木渉, 法川勇太郎, 野平俊之, 熔融 KF–KCl–K₂SiF₆ 中における液体 Ga 電極を用いた結晶性 Si 電析, 電気化学会第 91 回大会, 名古屋大学東山キャンパス, 2024.3.14-16

王昊琛, 法川勇太郎, 野平俊之, CsF–CsCl–WO₃ 熔融塩を用いた α -W 膜および β -W 膜の作製: 膜中酸素含有量の影響, 電気化学会第 91 回大会, 名古屋大学東山キャンパス, 2024.3.14-16

酒井佑輔, 法川勇太郎, 野平俊之, 熔融 LiCl–KCl–K₂CO₃ 中における炭素電析の電解条件依存性, 電気化学会第 91 回大会, 名古屋大学東山キャンパス, 2024.3.14-16

侯正陽, 茂木渉, 法川勇太郎, 野平俊之, 太陽電池への応用を目的とした KF–KCl 系熔融塩中における結晶性 p–Si 膜の電析, 電気化学会第 91 回大会, 名古屋大学東山キャンパス, 2024.3.14-16

T. Nohira, Y. Norikawa, Y. Horiba, R. Matsuyama, Electrochemical Synthesis of Diamond from Carbon Dioxide in Molten Salts, 11th KYOTO INTERNATIONAL FORUM FOR ENVIRONMENT AND ENERGY, Takinoyu Hotel, 2024.3.3-5

Y. Norikawa, M. Unoki, T. Nohira, Electrodeposition of Ti in Alkali Metal Fluoride–Chloride Melts, 11th KYOTO INTERNATIONAL FORUM FOR ENVIRONMENT AND ENERGY, Takinoyu Hotel, 2024.3.3-5

W. Moteki, Y. Norikawa, T. Nohira, Formation of Crystalline Si Using Liquid Zn Electrode in Molten KF–KCl–K₂SiF₆, 11th KYOTO INTERNATIONAL FORUM FOR ENVIRONMENT AND ENERGY, Takinoyu Hotel, 2024.3.3-5

川口健次, 野平俊之, 熔融塩電解と合金隔膜を利用したレアアースの新しい分離技術, 第 26 回レアメタル資源再生技術研究会, オンライン, 2024.3.25

H. Nishimura, K. Saito, N. Kobayashi, Y. Iseki, Y. Mizukoshi, Y. Makimura, Y. Minami, T. Hashizume, K. Kondo, M. Katahira, T. Watanabe, Structural analysis of lignocellulosic biomass by NMR spectroscopy toward decarbonized society, The 14th International Symposium of Advanced Energy Science, 京都大学宇治キャンパス, 2023.8.30-9.1

M. Takeda, T. Saito, U. Araki, K. Kondo, M. Katahira, Fermentation of a useful polysaccharide using hydrogen sulfide as energy source, The 14th International Symposium of Advanced Energy Science, 京都大学宇治キャンパス, 2023.8.30-9.1

R. Kurokawa, A. Kawakami, Y. Yamaoki, K. Kondo, T. Sakamoto, M. Katahira, Dynamics analysis of the nucleic acids in bio-molecular condensates by NMR, The 14th International Symposium of Advanced Energy Science, 京都大学宇治キャンパス, 2023.8.30-9.1

S. Waga, Y. Yamaoki, A. Eladl, K. Kamba, S. Hoshina, H. Horinouchi, K. Kondo, T. Nagata, M. Katahira, NMR analysis on the binding sites of human origin recognition complex subunit 1 to G-quadruplex structure of DNA, The 14th International Symposium of Advanced Energy Science, 京都大学宇治キャンパス, 2023.8.30-9.1

山置佑大, 永田崇, 近藤敬子, 阪本知樹, Eladl Omar, 片平正人, ヒト生細胞内核酸の構造ダイナミクスの in-cell NMR 法による解析, 第 17 回バイオ関連化学シンポジウム, 東京理科大学野田キャンパス, 2023.9.8

山置佑大, 永田崇, 近藤敬子, 阪本知樹, E. Omar, 片平正人, ヒト生細胞内核酸の構造ダイナミクスの in-cell NMR 法による解析, 第 17 回バイオ関連化学シンポジウム, 第 38 回生体機能関連化学シンポジウム, 第 26 回バイオテクノロジー部会シンポジウム, 東京理科大学野田キャンパス薬学部, 2023.9.8-10

大賀恵利, 八木勇成, 近藤敬子, 岡野啓志, 渡邊隆司, 永田崇, 片平正人, 選択的的白色腐朽菌の溶解性多糖モノオキシゲナーゼによる サトウキビ収穫廃棄物の糖化率促進効果, セルロース学会第 30 回年次大会, 広島国際会議場, 2023.9.28-29

O. Eladl, Y. Yamaoki, K. Kondo, T. Nagata, M. Katahira, In-cell NMR study of the structure and interaction of an RNA aptamer targeting HIV-1 Tat within living human cells, ISNAC 2023, Miyazaki Civic Plaza, 2023.11.1-3

山置佑大, E. Omar, 近藤敬子, 永田崇, 片平正人, In-cell NMR 法によるヒト細胞内における HIV Tat 捕捉 RNA アプタマーと標的分子との相互作用の解析, 第 62 回 NMR 討論会, 横須賀芸術劇場, 2023.11.7-9

永田崇, 山置佑大, 川上愛加, 近藤敬子, 阪本知樹, 片平正人, DNA 液滴の内部環境を NMR で調べる試み, 第 62 回 NMR 討論会, 横須賀芸術劇場, 2023.11.7-9

ケンネ テオジカイ, 近藤敬子, 齋藤香織, 井関優侑, 渡辺隆司, 永田崇, 片平正人, メンブレンリアクターを活用したリグニンペルオキシダーゼによる プナリグニンの高効率分解, 第 68 回リグニン討論会, シティ・ホールプラザ アオーレ長岡, 2023.11.9-10

増永泰成, 山置佑大, 中山千尋, 近藤敬子, 永田崇, 片平正人, NMR 法による DNA-RNA ハイブリッドグアニン四重鎖構造とペプチドの相互作用解析, 第 61 回日本生物物理学会年会, 名古屋国際会議場, 2023.11.14-16

増永泰成, 山置佑大, 中山千尋, 近藤敬子, 永田崇, 片平正人, NMR 法による DNA-RNA; ハイブリッドグアニン四重鎖構造と特異性が予想される化合物との相互作用解析, 第 46 回日本分子生物学会, 神戸ポートアイランド, 2023.12.6-8

K.S.K. Teo, K. Kondo, K. Saito, Y. Iseki, T. Watanabe, T. Nagata, M. Katahira, Highly efficient decomposition of beech wood lignin by lignin peroxidase using a membrane reactor, The 7th International KBMSS Symposium / 521st Sustainable Humanosphere Symposium, 京都大学宇治キャンパス, 2024.1.30

A. Phienluphon, K. Kondo, B. Mikami, K. Teo, K. Saito, T. Watanabe, T. Nagata, M. Katahira, Structure-function relationship of fungal feruloyl esterases towards destarched wheat bran, The 7th International KBMSS Symposium / 521st Sustainable Humanosphere Symposium, 京都大学宇治キャンパス, 2024.1.30

八木勇成, 大賀恵利, 近藤敬子, 岡野啓志, 渡辺隆司, 永田崇, 片平正人, 選択的的白色腐朽菌の溶解性多糖モノオキシゲナーゼを用いたサトウキビ収穫廃棄物パルプの分解, 日本農芸化学会, 東京農業大学世田谷キャンパス, 2024.3.24-27

荒木優衣, 斉藤頼昌, 近藤敬子, 片平正人, 武田穰, 混合栄養硫黄酸化細菌 *Thiothrix nivea* の酢酸代謝に及ぼす硫化水素の影響, 日本農芸化学会, 東京農業大学世田谷キャンパス, 2024.3.24-27

S. Chuaychob, Novel Process for Carbon Fixation Reaction Inspired by Natural Photosynthesis, 第 14 回エネルギー理工学研究所国際シンポジウム, 京都大学宇治キャンパス, 2023.9.1

S. Chuaychob, W. Hou, M. Shimizu, S. Nakano, A. Rajendran, E. Nakata, T. Morii, Mechanism of RNA Protein Aggregate Formation as a Cause of Triplet Repeat Disease, 第 16 回バイオ関連化学シンポジウム, 東京理科大学野田キャンパス, 2023.9.8-10

S. Chuaychob, W. Hou, M. Shimizu, S. Nakano, A. Rajendran, E. Nakata, T. Morii, In Vitro Study of Aggregate Formation between CUG Repeat RNA and MBNL1 Protein, 第 50 回国際核酸化学シンポジウム (2023 IS-NAC), Miyazaki Civic Plaza, 2023.11.1

S. Chuaychob, W. Hou, M. Shimizu, S. Nakano, A. Rajendran, P. Lin, E. Nakata, T. Morii, In Vitro Model of a Triplet-Repeat RNA Disease in Myotonic Dystrophy Type 1 Utilizing DNA Nanostructures, The 49th International Congress on Science, Technology and Technology-based Innovation (STT 49), Songkhla, Thailand, 2024.1.24

S. Chuaychob, W. Hou, M. Shimizu, S. Nakano, A. Rajendran, E. Nakata, T. Morii, In vitro model of RNA-Protein aggregates in myotonic dystrophy type 1, 日本化学会 第 104 春季年会, 日本大学理工学部, 2024.3.20