Kosuke Fujishima, PhD

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Educational background

Keio University, Systems Biology, Ph.D., 2009 (Early completion)
Keio University, Bioinformatics, MS, 2007
Keio University, Environmental Information, BS, 2005

Professional experience

2020-present	*Associate Professor,* ELSI/LST, Tokyo Institute of Technology
2019-2020	*Specially Appointed Associate Professor*, ELSI, Tokyo Institute of Technology
2018-2019	*Researcher,* ELSI, Tokyo Institute of Technology
2017-present	*Project Associate Professor,* Keio University
2016-2018	*EON Postdoctoral Fellow,* ELSI, Tokyo Institute of Technology
2015-2018	*Visiting Scientist,* USRA, NASA Ames Research Center
2015-2017	*Project Assistant Professor,* Keio University
2013-2015	*Assistant Research Scientist,* UARC, NASA Ames Research Center
2011-2013	*Postdoctoral Fellow*, NASA Ames Research Center
2011-2013	*Visiting Scholar*, UC Santa Cruz
2009-2011	*Postdoctoral Researcher*, Institute for Advanced Biosciences, Keio University

Honors and awards

2016	WIRED Audi INNOVATION AWARD 2016
2016	iGEM 2016 Best Measurement project (Advisor of Stanford-Brown joint team)
2015	iGEM 2015 Best Manufacturing project (Advisor of Stanford-Brown joint team)
2012	Best Poster Presentation, Gordon Research Seminar (GRS): Origin of Life, USA
2011	28th Inoue Research Award for Young Scientist, Inoue Foundation for Science, Japan

Research interest

The origin of life remains one of the fundamental questions in modern biology. The mystery lies in how the transition was made from the prebiotic world of inanimate chemicals to the Central Dogma-based biological system. At the heart of the issue is how RNA chain and polypeptides arose from the chemical disequilibria, interacted, and ultimately led to a functioning biological system. I had been working on transfer RNA, known as the molecular fossil that decodes genetic information on a nucleotide chain to an amino acid. In other words, tRNA is a molecule that bridges the gap between the generally accepted RNA world (RNA based biological system) and modern biology. Most attempts to understand the origin of life so far focus on RNA and hardly any work has been done on synthesizing abiotically produced short peptides that are likely existed earlier than chain of nucleotides on early Earth, let alone extraterrestrial environments. Hence, my research is centered on testing the 'peptide-RNA coevolution hypothesis' by synthesizing a large pool of *de novo* peptides and proteins in an *in vitro* system to understand their function, evolution and heredity prior to the emergence of genetic system. These challenging researches will become part of a role model for the emerging field of "Synthetic Astrobiology".

Publications (Recent 5 years)

Fried SD, **Fujishima K**, Makarov M, Cherepashuk I, Hlouchova K.Peptides before and during the nucleotide world: an origins story emphasizing cooperation between proteins and nucleic acids. *Journal of the Royal Society Interface*.Feb.2022; volume19(187)(2022)

Caner Akıl, Samson Ali, Linh T Tran, Jeremie Gaillard, Wenfei Li, Hayashida K, Hirose M, Kato T, Oshima A, **Fujishima K**, Laurent Blanchoin, Akihiro Narita, Robert C Robinson.Structure and dynamics of Odinarchaeota tubulin and the implications for eukaryotic microtubule evolution. *bioRxiv*,submitted.

Tretyachenko V, Vymetal J, Neuwirthova T, Vondrasek J, **Fujishima K**, Hlouchová K. Structured

proteins are abundant in unevolved sequence space. *bioRxiv*, submitted.

Giacobelli VG, **Fujishima K**, Lepšík M, Tretyachenko V, Kadavá T, Makarov M, Bednárová L, Novák P, Hlouchová K. In vitro evolution reveals non-cationic protein-RNA interaction mediated by metal ions. *Mol Biol Evol*. 2022 Feb 8:msac032.

Reyes SG, Kuruma Y, Fujimi M, Yamazaki M, Eto S, Nishikawa S, Tamaki S, Kobayashi A, Mizuuchi R, Rothschild L, Ditzler M, **Fujishima K**. PURE mRNA display and cDNA display provide rapid detection of core epitope motif via high-throughput sequencing. *Biotechnol Bioeng.* 2021 Apr;118(4):1736-1749.

Tretyachenko V, Voráček V, Souček R, **Fujishima K**, Hlouchová K. CoLiDe: Combinatorial Library Design tool for probing protein sequence space. *Bioinformatics*, btaa804 (2020)

Jia TZ, **藤島 皓介**, 丹羽 達也, 液ー液相分離と生命の起源. 生物工学会誌 第 98 巻 第 5 号 228–254（2020）

Wang P*, **Fujishima K***, Berhanu S, Kuruma Y, Jia T, Khusnutdinova AN, Yakunin AF, and McGlynn SE. A bi-functional polyphosphate kinase driving NTP regeneration and reconstituted cell-free protein synthesis. *ACS Synbio*, *9* (1), 36-42. (2019)

Takahagi W, Seo K, Shibuya T, Takano Y, **Fujishima K**, Saitoh M, Shimamura S, Matsui Y, Tomita M and Takai K. Peptide synthesis under the alkaline hydrothermal conditions on Enceladus. *ACS Earth Space Chem*, 3, 11, 2559-2568. (2019)

Urbina J, Patil A, **Fujishima K**, Paulino-Lima IG, Saltikov C, Rothschild LJ. A new approach to biomining: Bioengineering surfaces for metal recovery from aqueous solutions. *Sci Rep*. 9(1), 16422. (2019)

Fujishima, K., Dziomba, S, Yano H, Kebe SI, Guerrouache M, Carbonnier B, and Rothschild, LJ. The non-destructive separation of diverse astrobiologically relevant organic molecules by customizable capillary zone electrophoresis and monolithic capillary electrochromatography. *Int J Astrobiol*, 18, 6, 562-574. (2019)

Vecchioni S, Capece MC, Toomey E, Nguyen L, Ray A, Greenberg A, **Fujishima K**, Urbina J, Paulino-Lima IG, Pinheiro V, Shih J, Wessel G, Wind SJ, Rothschild LJ. Construction and characterization of metal ion-containing DNA nanowires for synthetic biology and nanotechnology. *Sci Rep*, 9(1), 6942. (2019)

Fujishima, K., Wang, K. M., Palmer, J. A., Abe, N., Nakahigashi, K., Endy, D., and Rothschild, L. J. Reconstruction of cysteine biosynthesis using engineered cysteine-free enzymes. *Sci Rep*, 8(1), 1776. (2018)

Kaneta A, **Fujishima K**, Morikazu W, Hori H, Hirata A. The RNA-splicing endonuclease from the euryarchaeaon Methanopyrus kandleri is a heterotetramer with constrained substrate specificity. *Nucleic Acids Res*. 46(4):1958-1972. (2018)

Froese, T., Campos, J. I., **Fujishima, K**., Kiga, D., and Virgo, N. Horizontal transfer of code fragments between protocells can explain the origins of the genetic code without vertical descent. *Sci Rep*, 8(1), 457. (2018)

Kitadai N., Kameya M. and **Fujishima K**. Origin of the Reductive Tricarboxylic Acid (rTCA) Cycle-Type CO2 Fixation: A Perspective. *Life*, 7(4), 39. (2017)