



HIROSHIMA UNIVERSITY
GRADUATE SCHOOL OF INTEGRATED SCIENCES FOR LIFE

〈プログラム共同セミナー〉

Joint Seminar of the Program of Mathematical and Life Sciences

演題／Title:

DNA as a Programmable Scaffold for Protein Organization, Delivery and Imaging



講演者／Speaker:

Sergii Rudiuk

Ecole Normale Supérieure de Paris, CNRS

日時／Date and Time:

2026 年 11 月 10 日 (火) 14:35–15:20

Tuesday, October 13, 2026, 14:35–15:20

場所／Venue:

理学部 E102 講義室

Lecture Room E102, Faculty of Science

概要／Abstract:

Although the primary biological function of DNA is the storage and transmission of genetic information, its unique chemical structure enables a wide range of in vitro applications, from biotechnology to materials science. In particular, the programmability of DNA makes it a versatile molecular scaffold for organizing, transporting and even visualizing proteins at the nanoscale. First, I will describe hybrid DNA-protein nanogels formed by crosslinking multibiotinylated DNA with streptavidin or streptavidin-enzyme conjugates. These compact DNA-rich particles can incorporate high local concentrations of functional proteins while remaining compatible with conventional nucleic-acid transfection strategies. This approach enabled intracellular delivery of different protein cargos, including catalytically active enzymes, while preserving their activity. I will then present thermodynamically controlled DNA origami, in which massive strand displacement allows DNA nanostructures to assemble and undergo global isothermal shape transformations. This structural remodeling was used to reposition proteins attached to the origami scaffold, changing the distance between glucose oxidase and horseradish peroxidase and controlling the activity of their coupled enzymatic cascade. Finally, I will present an original approach in which DNA serves as a physically readable molecular label for atomic force microscopy (AFM). Site-selective conjugation of programmable length DNA tags to α -synuclein allows individual DNA arms to be visualized and counted by AFM, providing a direct way to determine the aggregation number of individual protein oligomers and opening the way to molecular barcoding of heterogeneous protein assemblies. Together, these examples highlight the potential of DNA-protein conjugates and show how the molecular programmability of DNA can bridge nanoscale engineering, biological function and quantitative measurement, opening new possibilities for designing and interrogating complex biomolecular systems.

Organizer: Masatoshi Ichikawa, Program of Mathematical and Life Sciences

Contact: ichikaw@hiroshima-u.ac.jp, Tel: +81-82-424-7336