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2024- Present	Professor, Department of Life Science and Technology, Science Tokyo, Japan
2023-2024	Professor, Department of Life Science and Technology, Tokyo Tech., Japan
2005-2022	Associate Professor, SANKEN, Osaka University, Japan
1999-2005	Research Associate, SANKEN, Osaka University, Japan
1999 PhD	Kyoto University, Japan, Advisors: Prof. Isao Saito, Prof. Hiroshi Sugiyama, Thesis: *Chemical studies on the regulation of DNA structures and Z-DNA specific reactions*
1996 MS	Kyoto University, Japan
1994 BS	Kyoto University, Japan

Research Interests:
Single-molecule DNA Analysis, Photochemistry, Reaction Kinetics

Selected Publications:

1. Fan, S., T. Takada T., Maruyama A., Fujitsuka M., Kawai K.*, Programmed Control of Fluorescence Blinking Patterns Based on Electron Transfer in DNA, ***Chem. Eur. J.***, **2023**, *29*, e202203552.

2. Fan, S., Xu, J., Osakada, Y., Hashimoto, K., Takayama, K., Natsume, A., Hirano, M., Maruyama, A., Fujitsuka, M., Kawai, Kumi*, Kawai, K.*, Electron-Transfer Kinetics through Nucleic Acids Untangled by Single-Molecular Fluorescence Blinking, ***Chem***, **2022**, *8*, 3109.

3. Xu, J., Fan, S., Xu, L., Maruyama, A., Fujitsuka, M., Kawai, K.*, Control of Triplet Blinking Using Cyclooctatetraene to Access the Dynamics of Biomolecules at the Single‐Molecule Level, ***Angew. Chem. Int. Ed.*** **2021**, 12941.

4. Kawai, K.*, Fujitsuka, M., Maruyama A., Single-Molecule Study of Redox Reaction Kinetics by Observing Fluorescence Blinking, ***Acc. Chem. Res.*** **2021**, *54*, 1001.

5. Kawai K.*, Miyata, T., Shimada, N., Ito, S., Miyasaka, H., Maruyama, A.*, Single-Molecule Monitoring of the Structural Switching Dynamics of Nucleic Acids through Controlling Fluorescence Blinking, ***Angew. Chem. Int. Ed.*** **2017**, *56*, 15329.

Control of Triplet Blinking to Access DNA Dynamics at the Single Molecule level

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Abstract

To achieve ultra-sensitive analysis, one strategy would be to focus on an analytical method that relies on properties of molecules that are highlighted when we look at molecules at the single molecule level. We have focused on a phenomenon called fluorescence blinking. During the repeated cycles of excitation and emission, fluorescent molecules can occasionally enter non-fluorescent OFF states, such as (a) the reduced or oxidized state triggered by photo-induced electron transfer, (b) the triplet state resulting from intersystem crossing, (c) the isomerized state formed by photo-triggered *trans-cis* isomerization. Reversible formation of such OFF states causes a fluorescence blinking. The kinetics of a chemical reaction concomitant with blinking can be followed by the duration of the ON state (τ_{ON}) and that of the OFF state (τ_{OFF}). Based on the understanding of factors that affect the blinking, single fluorescent molecules can serve as reporters of their local microenvironment. We developed a method, termed **K**inetic **A**nalysis based on the **C**ontrol of fluorescence **B**linking (KACB). The blinking kinetics or patterns were controlled to reflect the microenvironment changes around the fluorophore. KACB method was adapted for detection of target DNA and RNA, and for investigation of antigen-antibody interactions at the single molecule level. In this talk, I would focus on the blinking controlled by triplet-triplet energy transfer (TTET) which allow us to access the dynamics of nucleic acids.