# Curriculum Vitae


**Name**

Ya-Ting Kao

**Current Position**

Associate Professor

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**Education & Professional Experiences**

**Education**

Doctor of Philosophy - Dept. Chem. and Biochem., The Ohio State University, United States (2010).

Master of Science - Dept. Chemistry, National Tsing Hua University, Taiwan (2000).

Bachelor of Science - Dept. Chemistry, National Tsing Hua University, Taiwan (1998).

**Professional Experiences**

Current position: Associate Professor and group leader, Dept. of Biological Science and Technology, National Yang Ming Chiao Tung University, Hsinchu, Taiwan (since August 2022).

Assistant Professor: Dept. of Biological Science and Technology, National Yang Ming Chiao Tung University, Hsinchu, Taiwan (August 2012-July 2022)

Postdoc: Department of Chemistry, Columbia University, New York, United States (September 2010 - June 2012)

Research Associate: Department of Applied Chemistry, National Chiao Tung University (2002-003)

Instructor in Chemistry: Wu-Ling Senior High School, Taoyuan, Taiwan, 2001-2002
Chu-Tung Senior High School, Hsinchu, Taiwan, 2000-2001

**Research Interests**

My research focuses on investigating the conformational dynamics of biological macromolecules using biophysical approaches, including time-resolved spectroscopy and single-molecule microscopy. Specifically, my interests center on two main themes: (1) elucidating how protein conformational fluctuations influence protein function and enzyme catalysis; and (2) understanding macromolecular assemblies, such as protein–protein and protein–DNA interactions.

**Selected Publications**


1. M.-S. Su and Y.-T. Kao, Effects of substrate length and active-site residue on catalytic function of fatty acid photodecarboxylase. *Phys. Chem. Chem. Phys.,* ***2026****, 28, 1781–1791.*
2. M.-S. Su and Y.-T. Kao, Characterization of fatty acid photodecarboxylase in zeolitic imidazolate frameworks. *ACS Omega,* **2025***, 10, 35595–35603.*
3. K.-W. Huang, C.-Y. Wu, S.-I. Toh, T.-C. Liu, C.-I. Tu, Y.-H. Lin, A.-J. Cheng, Y.-T. Kao, J.-W. Chu and Y.-Y. Hsiao, Molecular insight into the specific enzymatic properties of TREX1 revealing the diverse functions in processing RNA and DNA/RNA hybrids. *Nucleic Acids Res.,* **2023***, 51, 11927–11940.*
4. K.-W. Huang, J.-W. Chen, T.-Y. Hua, Y.-Y. Chu, T.-Y. Chiu, J.-Y. Liu, C.-I. Tu, K.-C. Hsu, Y.-

T. Kao, J.-W. Chu and Y.-Y. Hsiao, Targeted covalent inhibitors allosterically deactivate the DEDDh Lassa fever virus NP exonuclease from alternative distal sites. *JACS Au,* **2021***, 1, 2315–2327.*
5. C.-H. Huang, Y.-W. Chen, T.-T. Huang and Y.-T. Kao, Effects of distal mutations on ligand-binding affinity in E. coli dihydrofolate reductase. *ACS Omega,* **2021***, 6, 26065–26076.*

**Lecture Title**

Characterization of Fatty Acid Photodecarboxylase in Zeolitic Imidazolate Frameworks and with Various Substrates

**Abstract (500 words maximum)**

Fatty acid photodecarboxylases (FAPs) are recently discovered photoenzymes in microalgae that harvest blue light to catalyze the decarboxylation of long-chain fatty acids into $C_{n-1}$ hydrocarbons and $CO_2$. Owing to their environmentally friendly catalytic mechanism, FAPs have attracted considerable attention; however, key aspects governing their catalytic efficiency, including substrate interactions, electron transfer (ET) dynamics, and structural stability under illumination, remain insufficiently understood. In particular, the hydrophobic nature of both substrates and photoproducts poses challenges for in vitro studies, affecting enzyme stability and function.

In this work, we systematically investigate the interplay between substrate properties, enzyme dynamics, and structural confinement using Chlorella variabilis FAP (cvFAP). Substrate binding affinity, product formation, and initial ET dynamics were examined using fatty acids of varying chain lengths under different cosolvent conditions. Ethanol was found to enhance substrate solubility while increasing enzyme flexibility, thereby elongating the flavin–substrate distance ($D_{FAD-substrate}$) and reducing fluorescence quenching efficiency. Time-resolved fluorescence measurements reveal a clear substrate-length dependence of ET dynamics, with longer-chain substrates exhibiting shorter $D_{FAD-substrate}$ distances and faster initial ET rates. Product formation was quantified using a fluorometric assay, enabling estimation of catalytic half-lives and revealing that rapid conversion can arise from competitive binding between substrate and product.

To further probe structure–function relationships, site-directed mutagenesis was performed at residue N170, located proximal to the FAD cofactor. These variants significantly altered the partitioning of excited-state $1^1$FAD* pathways, thereby modulating photocatalytic efficiency and photostability. Complementarily, we employed zeolitic imidazolate frameworks (ZIFs) as protective confinement matrices to examine how nanoscale environments influence cvFAP behavior. ZIF-8 (hydrophobic surface) and ZIF-90 (hydrophilic surface) exhibit distinct morphologies—cluster-like and hexagon-like, respectively—yet both impose structural compression on the enzyme, resulting in a more hydrophobic active-site environment with reduced water accessibility.

Encapsulation within ZIF-90 enhances enzymatic activity at elevated temperatures, indicating improved thermal robustness. However, under photoirradiation, FAP undergoes competing excited-state deactivation and photoinactivation processes. In both ZIF systems, excited-state deactivation is slightly enhanced, likely due to conformational distortion of the flavin cofactor. Although ZIF encapsulation provides partial structural protection, it remains insufficient to fully prevent photodamage arising from radical-induced fragmentation.

Overall, this study integrates spectroscopic characterization, mutagenesis, and nanoconfinement strategies to elucidate how substrate properties, local environment, and protein structure collectively govern FAP photocatalysis. These findings provide mechanistic insights into the regulation of light-driven enzymatic reactions and inform future design strategies for improving the stability and efficiency of photoenzymes in biotechnological applications