

# Literature Report



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Article

## Enabling *In Vivo* Photocatalytic Activation of Rapid Bioorthogonal Chemistry by Repurposing Silicon-Rhodamine Fluorophores as Cytocompatible Far-Red Photocatalysts

Chuanqi Wang,<sup>#</sup> He Zhang,<sup>#</sup> Tao Zhang, Xiaoyu Zou, Hui Wang, Julia E. Rosenberger, Raghu Vannam, William S. Trout, Jonathan B. Grimm, Luke D. Lavis, Colin Thorpe, Xinqiao Jia,\* Zibo Li,\* and Joseph M. Fox\*

Reporter: Kai An

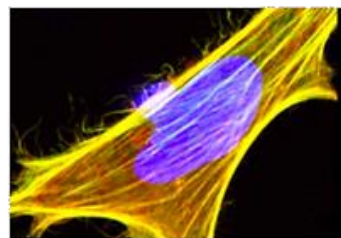
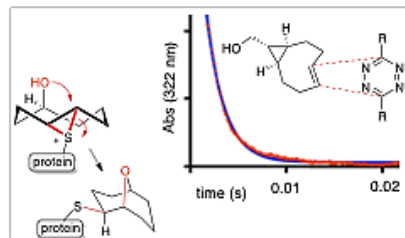
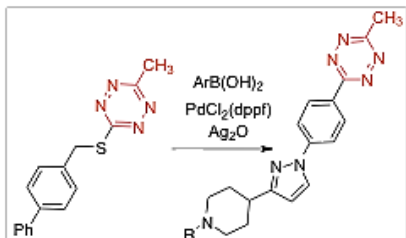
Date: 2021-07-22

# About the Author



## Joseph M. Fox, University of Delaware

Professor, Department of Chemistry and Biochemistry  
Professor, Department of Materials Science and Engineering  
PI and Director, NIH Center of Biomedical Research Excellence  
on Discovery of Chemical Probes and Therapeutic Leads

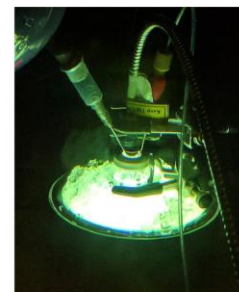


*Designing New Reactions for Chemical Biology*

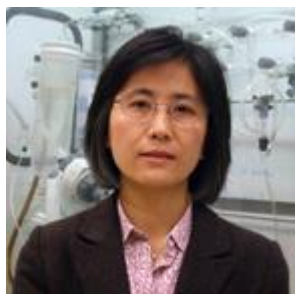


## Zibo Li, University of North Carolina

Doctorate: University of Virginia  
Post-Doctorate: Stanford University  
Molecular Imaging Program at Stanford (MIPS)



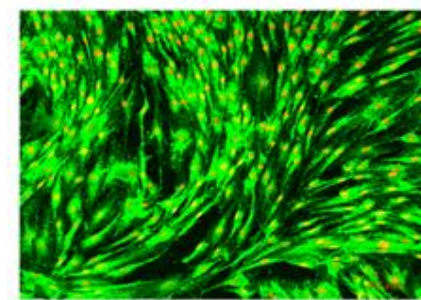
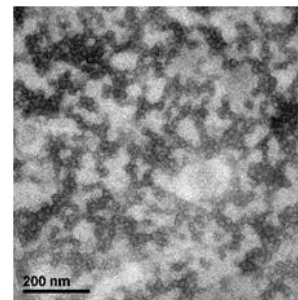
*radiochemistry, imaging, and therapy*



## Xinqiao Jia, University of Delaware

Department of Materials Science and Engineering  
Department of Biomedical Engineering  
Center for Translational Cancer Research (CTCR)  
Delaware Biotechnology Institute (DBI)

*Functional Biomaterials, Tissue Engineering*

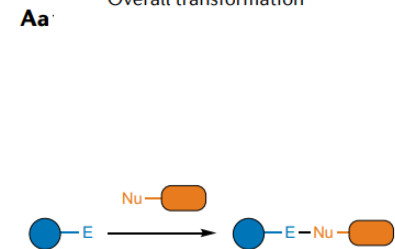


# Bioorthogonal Chemistry

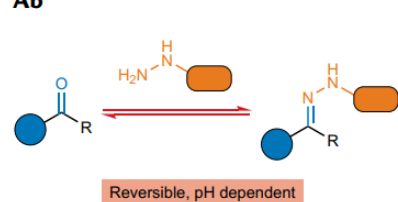
生物正交化学 (Bioorthogonal chemistry) 指能在生物系统中发生而且不干扰内源性生物化学过程的化学反应。

## A Polar reactions

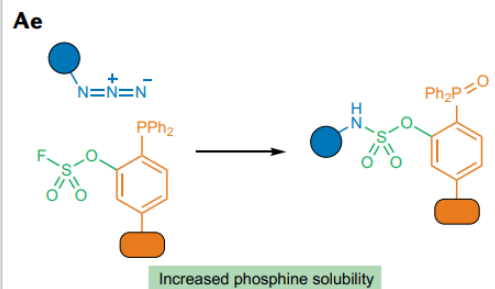
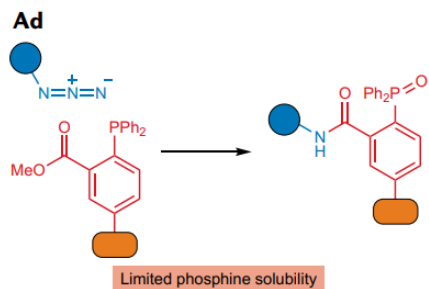
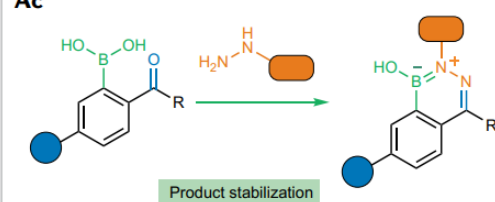
Overall transformation



**Ab** Early example

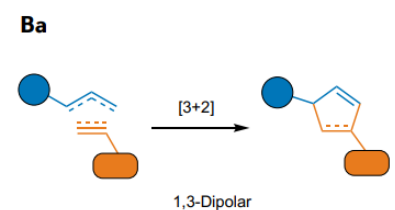


**Ac** Tuned variant

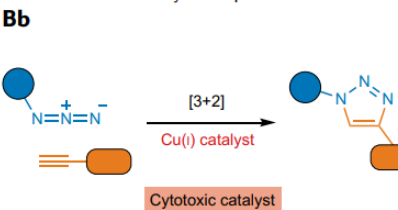


## B Cycloaddition reactions

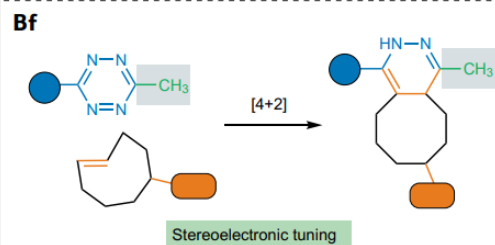
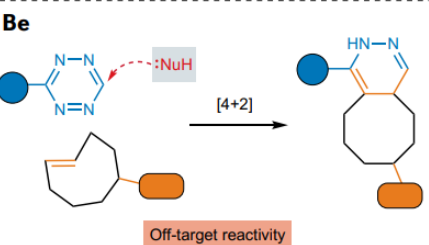
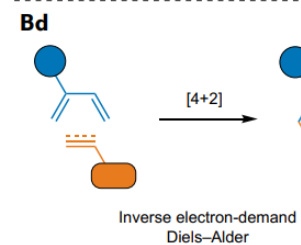
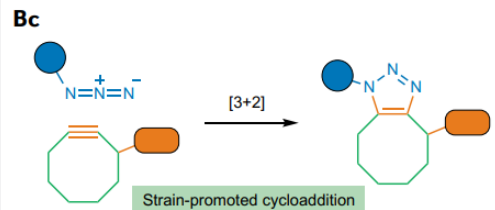
Overall transformation



**Bb** Early example

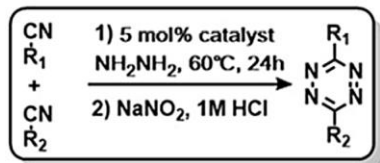


**Bc** Tuned variant



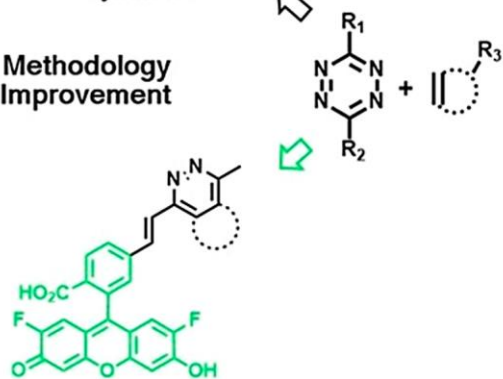
选择性  
化学与生物学惰性  
动力学  
生物兼容性  
可操作性

# Bioorthogonal Chemistry

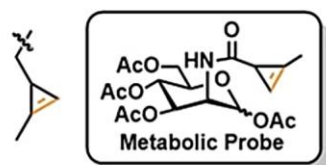


Bottom-Up Tetrazine Synthesis

Methodology Improvement



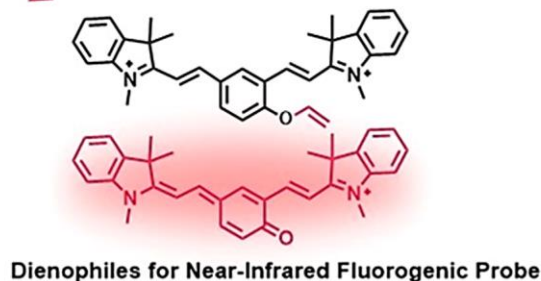
In situ Synthesis Alkenyl-Tetrazine Fluorogenic Probes for Live-Cell Imaging



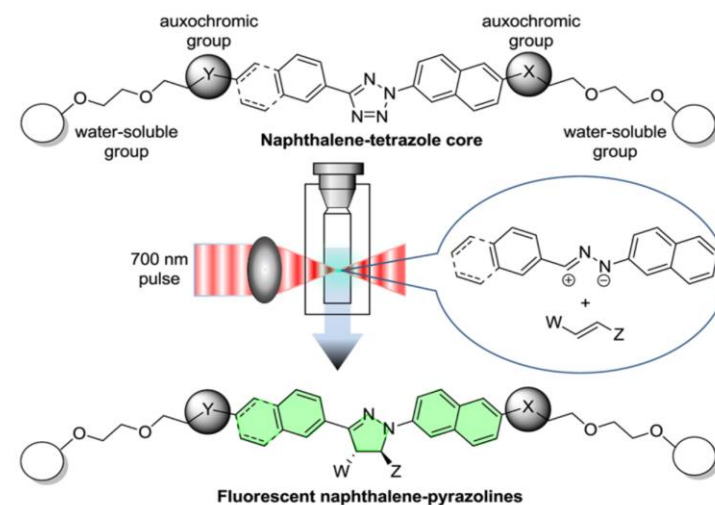
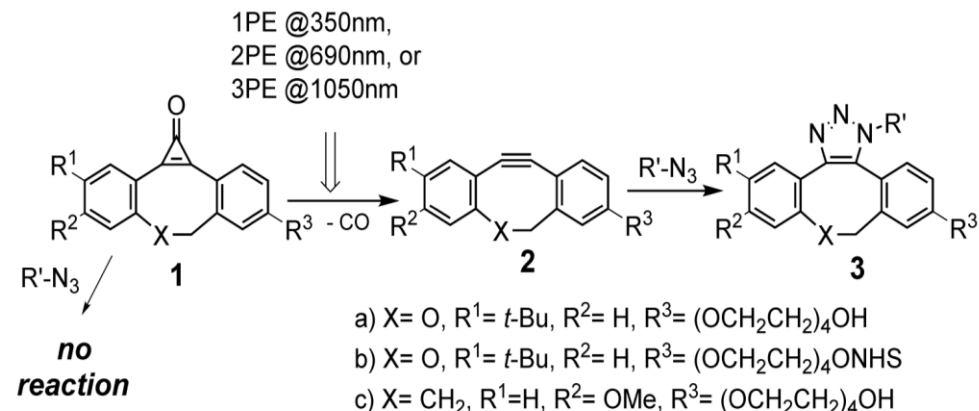
Dienophiles as "Mini-Tag"

Dienophile Expansion

Dienophiles for Tetrazine-Mediated Transfer Reaction



Dienophiles for Near-Infrared Fluorogenic Probe

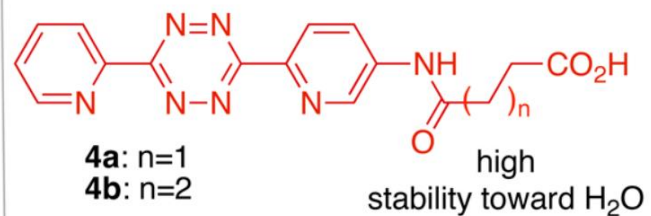
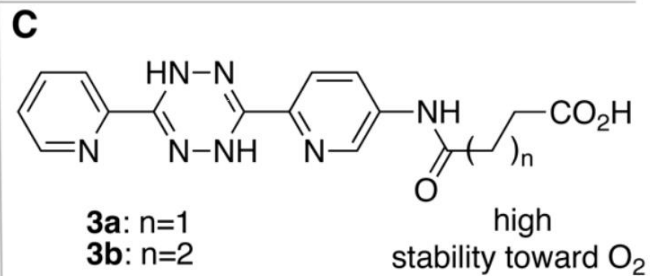
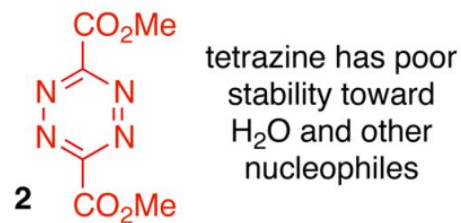
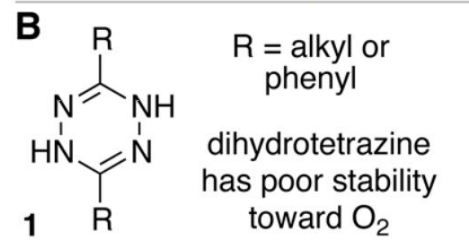
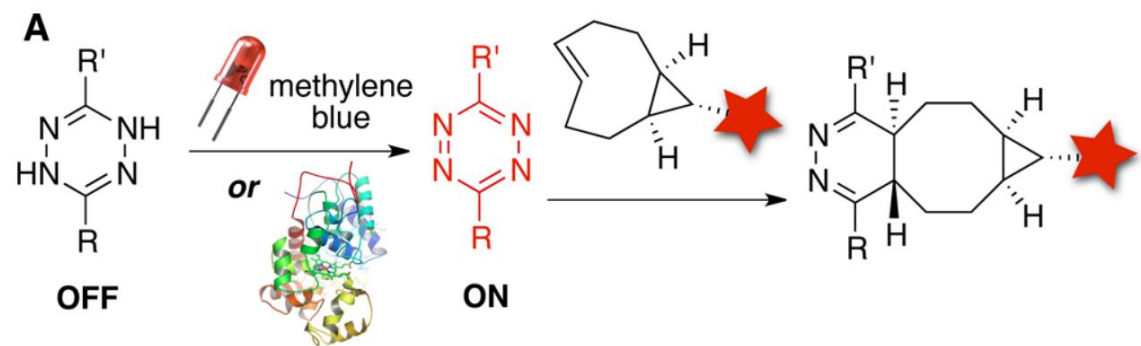


*J. Am. Chem. Soc.* **2013**, 135, 16766–16769

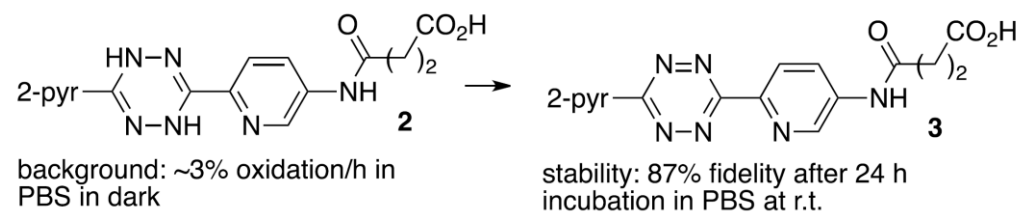
*J. Am. Chem. Soc.* **2017**, 139, 14029–14032

*Acc. Chem. Res.* **2018**, 51, 1249–1259

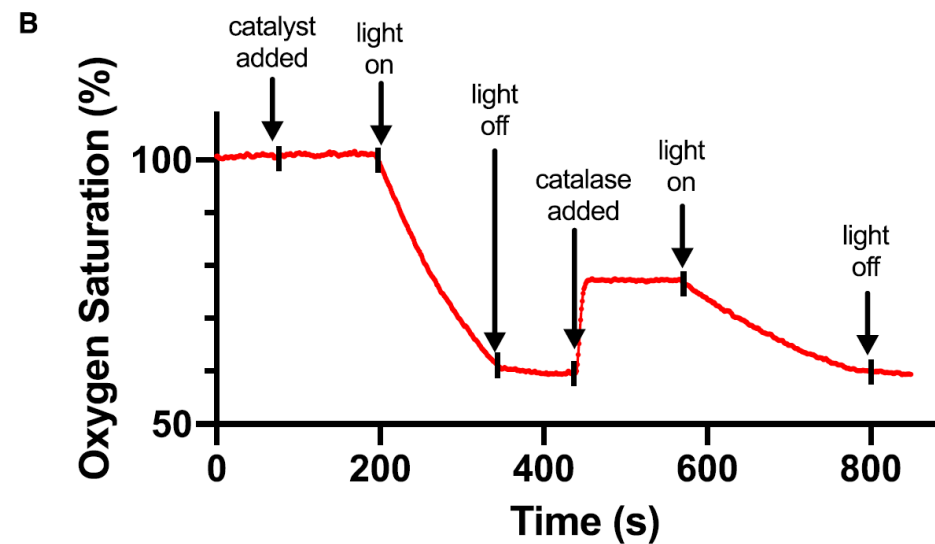
# Previous work



## A. Previous DHTz/Tz system

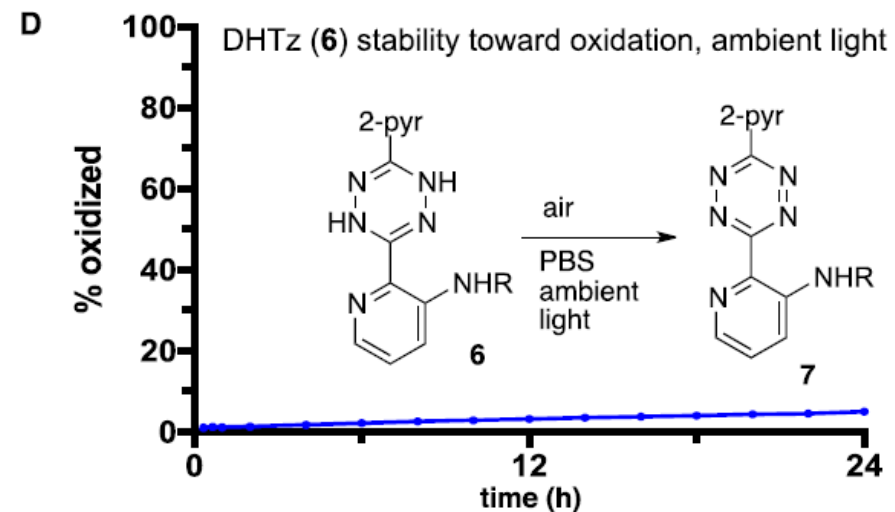
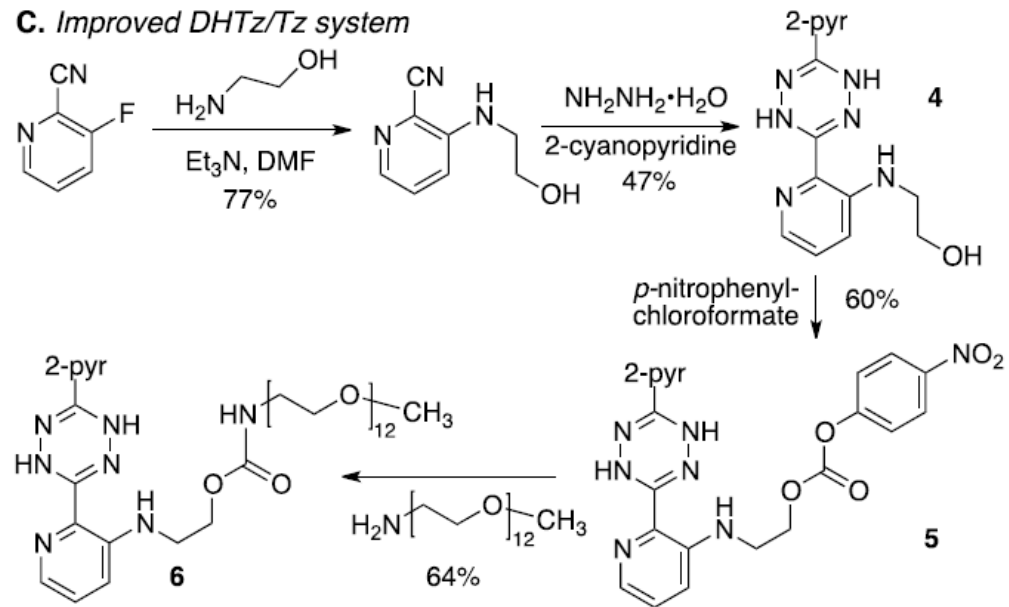


$$K=80200 \pm 1700 \text{ M}^{-1}\text{s}^{-1}$$

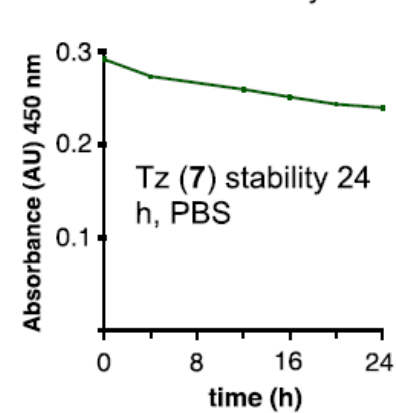


# Improvement of DHTz/Tz System Stability

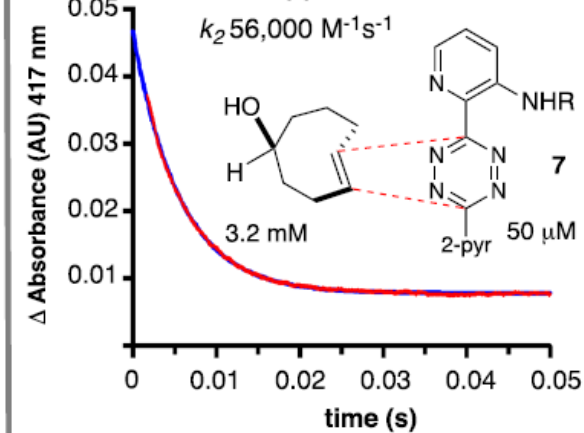
## C. Improved DHTz/Tz system



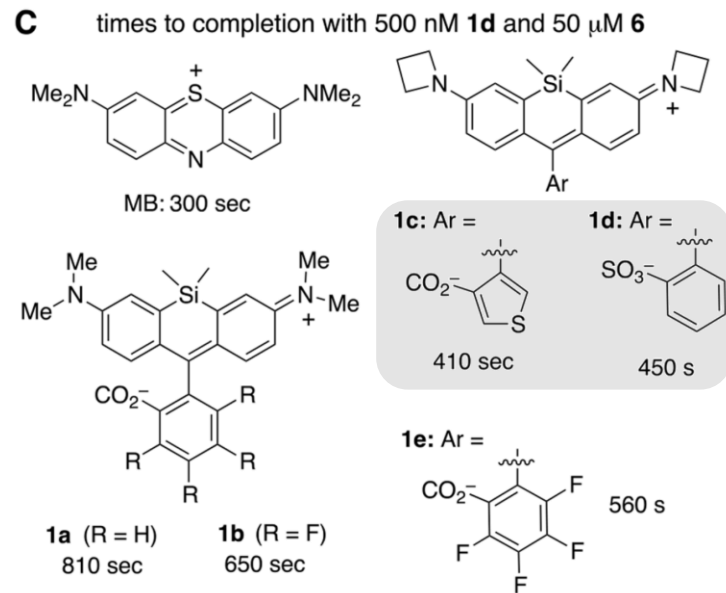
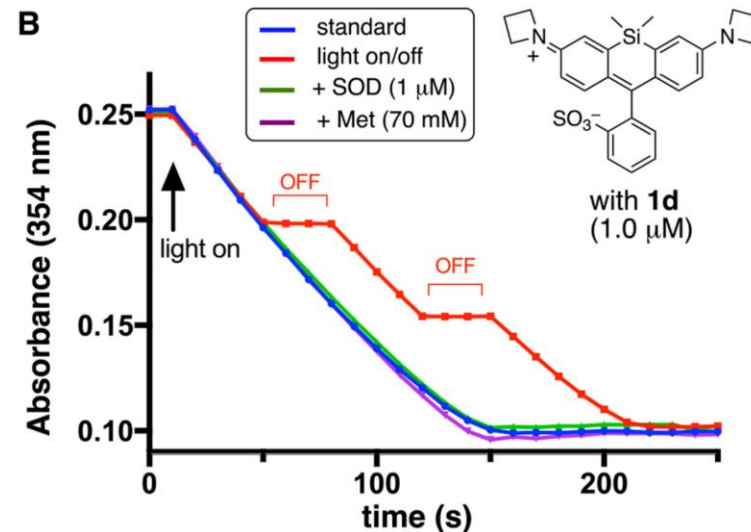
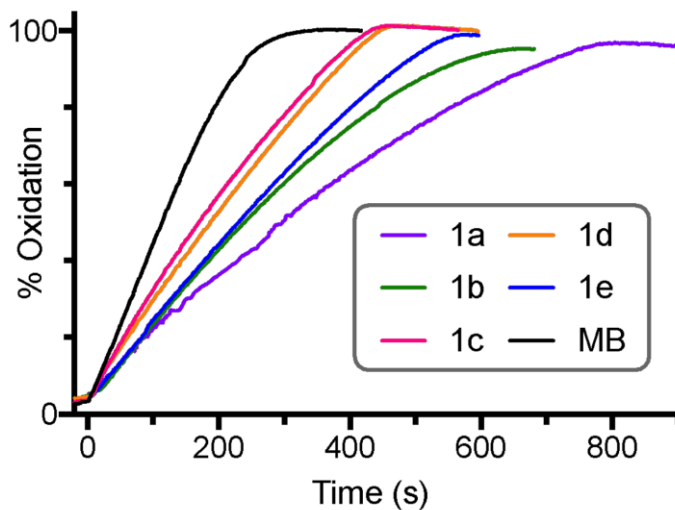
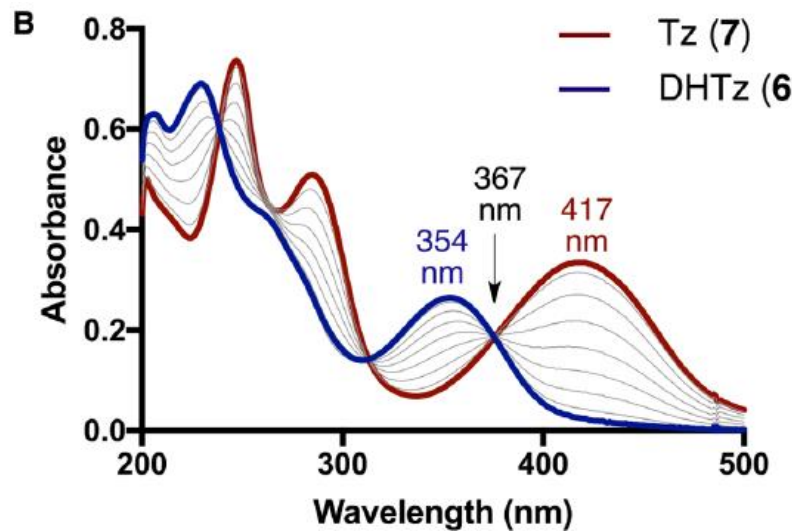
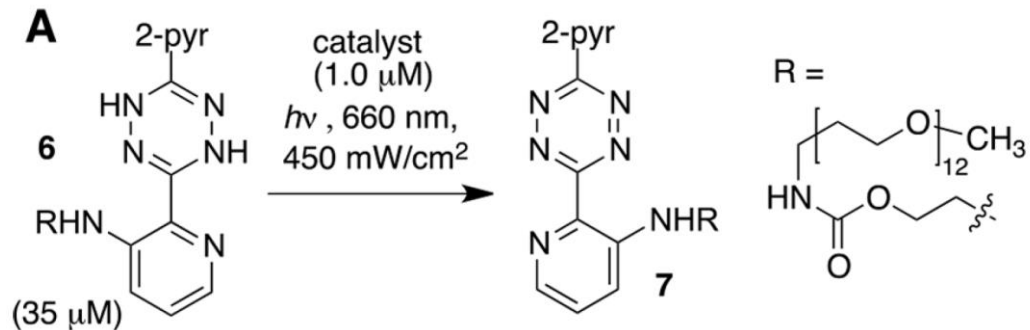
## E tetrazine stability



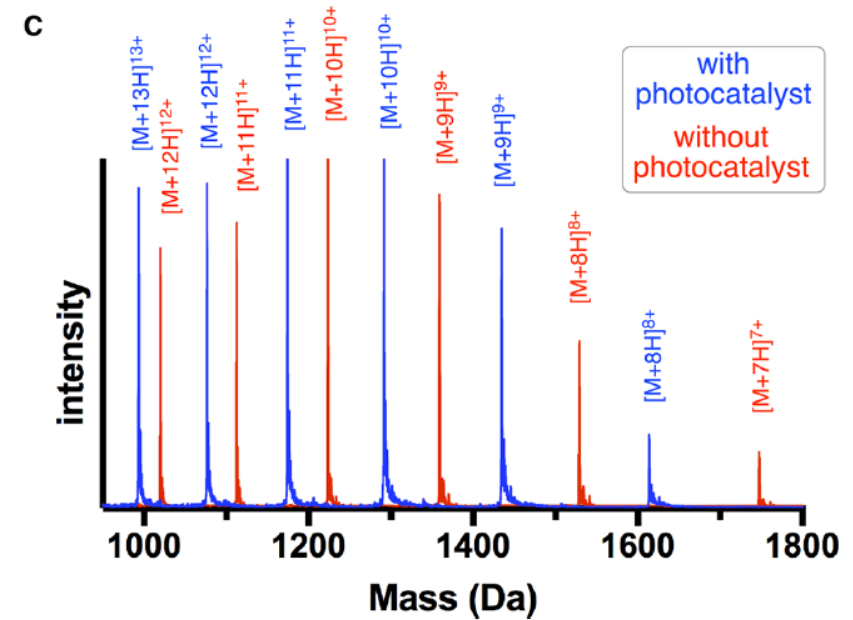
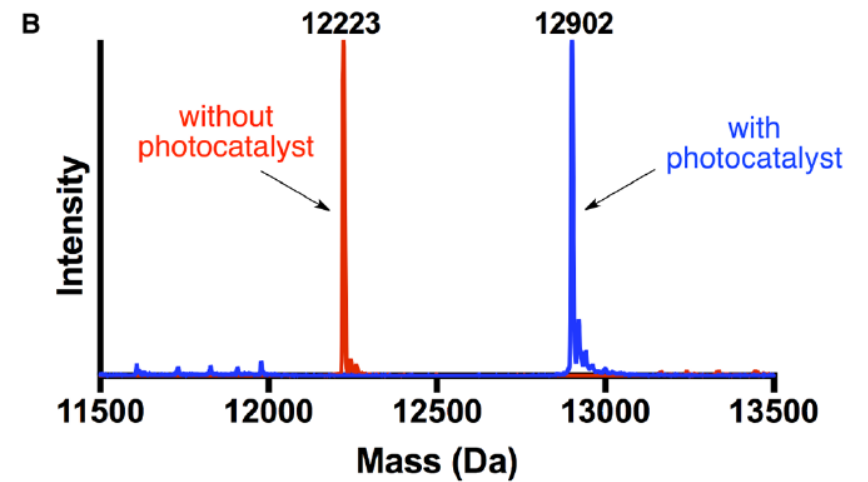
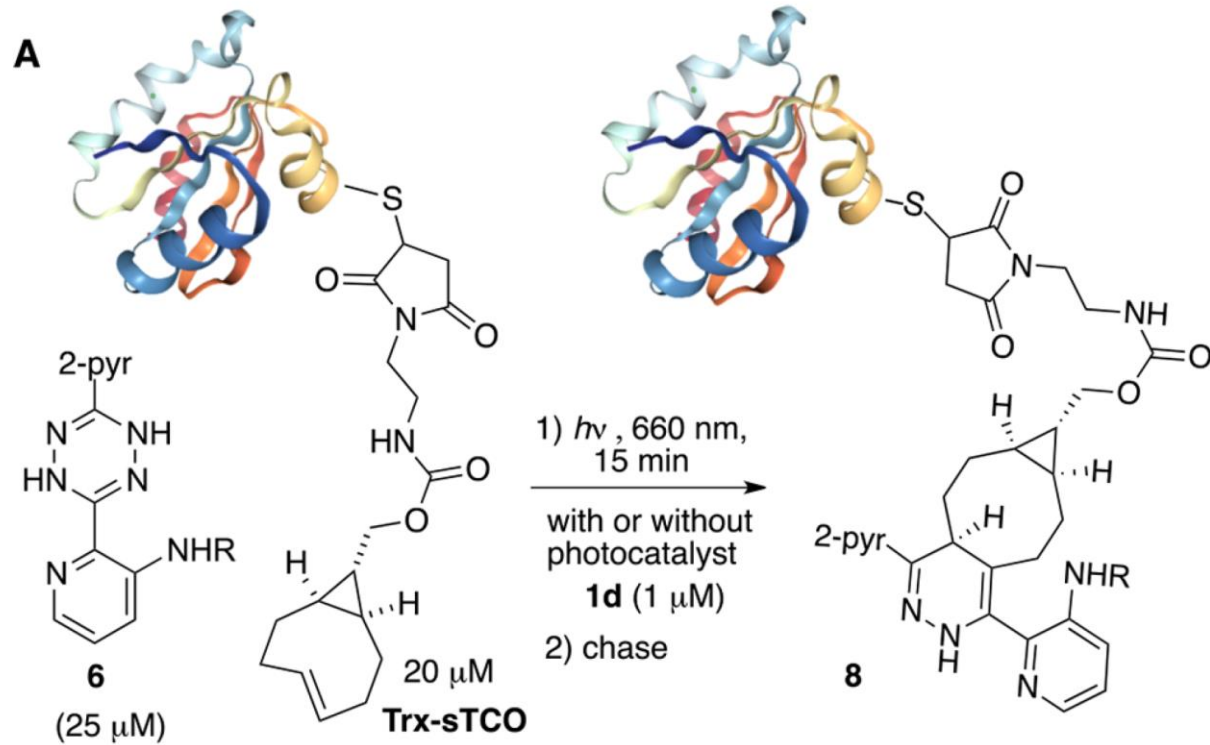
## F stopped flow kinetics



# Improvement of DHTz/Tz System Stability

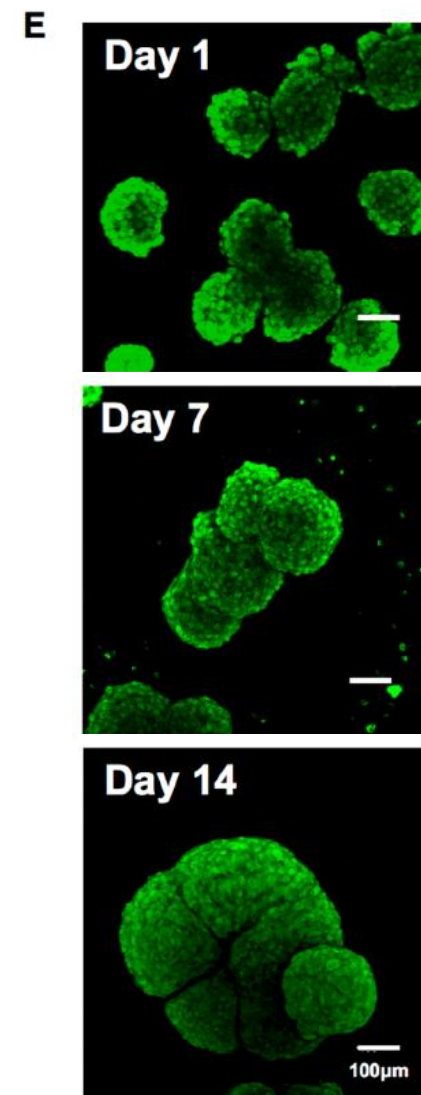
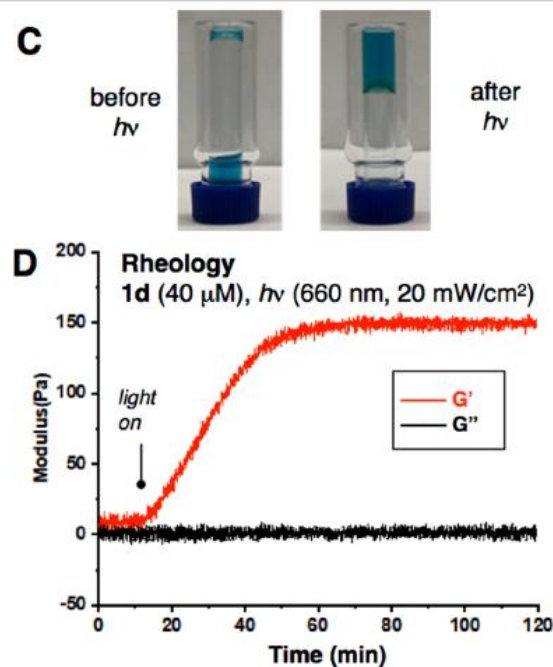
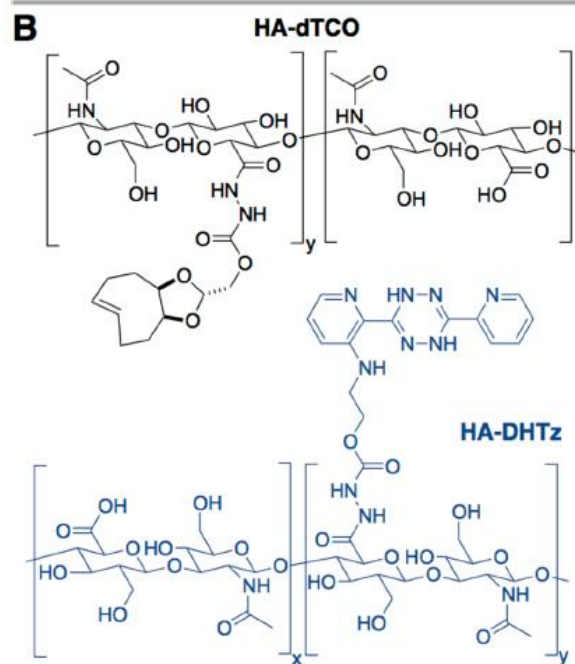
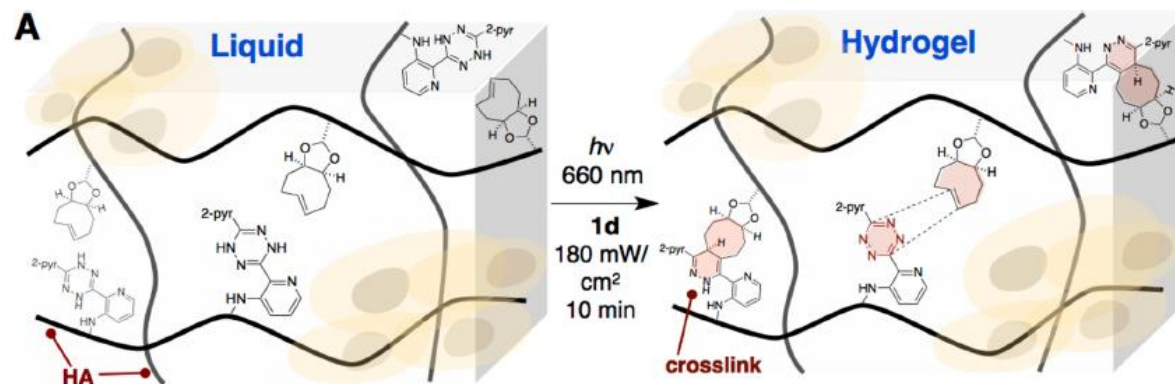


# *in situ* Protein Conjugation



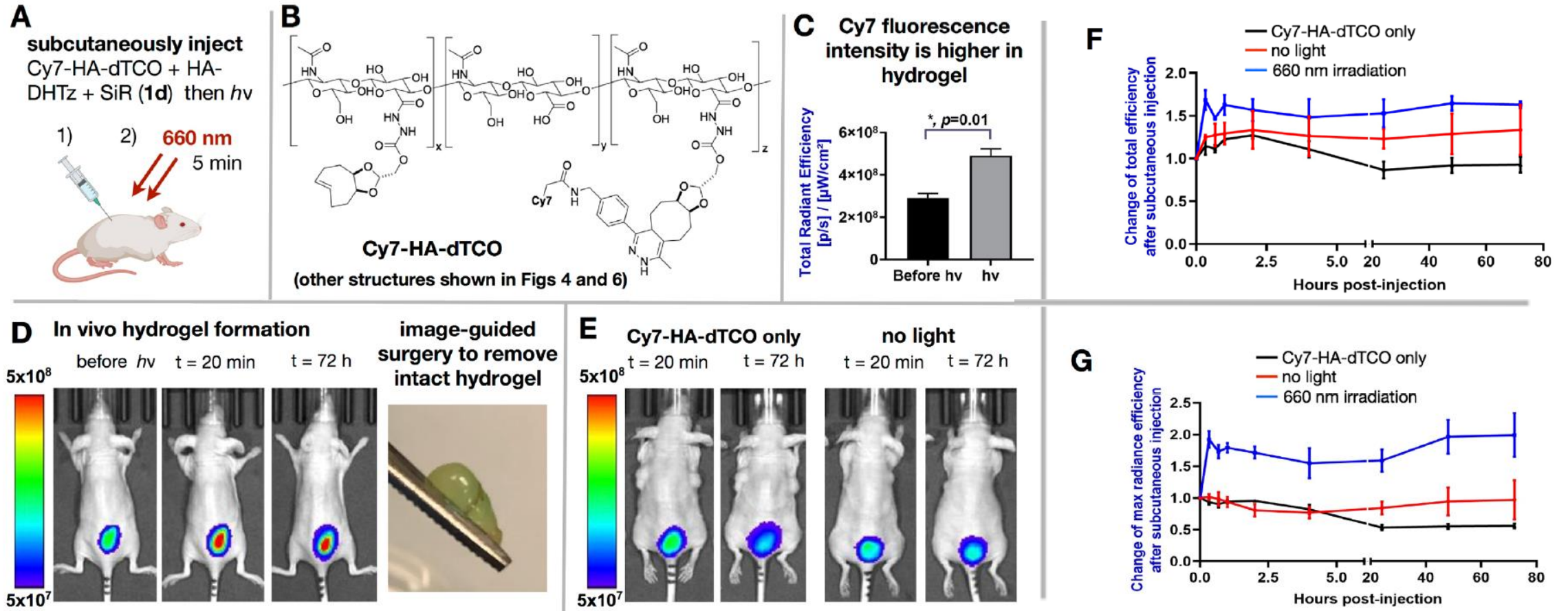


# Tetrazine Ligation for Cell Encapsulation in HA Hydrogels

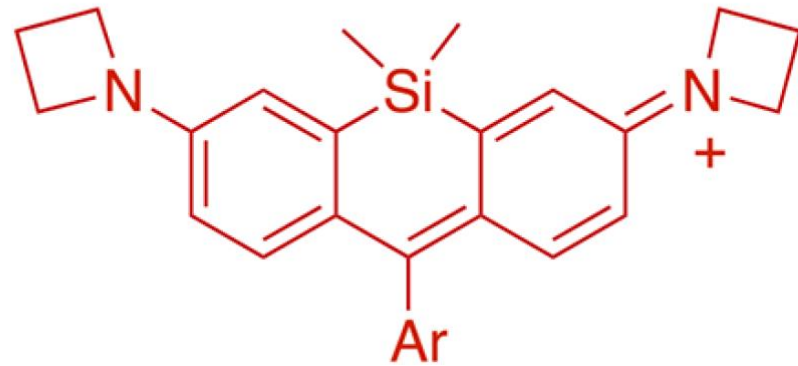
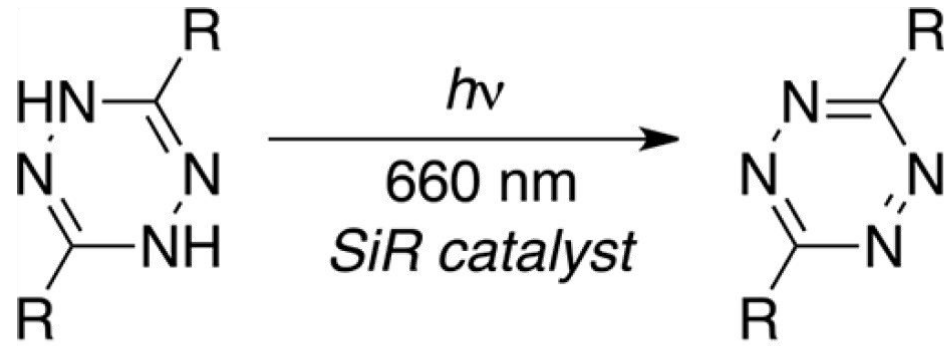


储能模量  $G'$  : 反映材料弹性大小  
损耗模量  $G''$  : 反映材料粘性大小

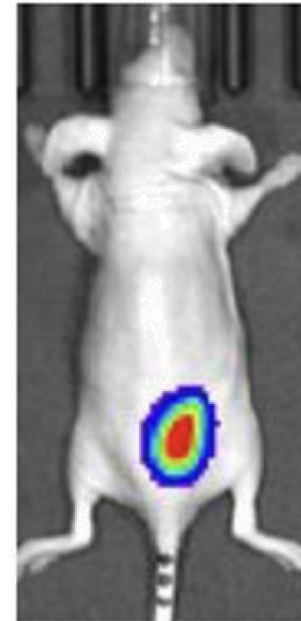
# Tetrazine Ligation in HA Hydrogels



# Conclusion



*in vivo*  
photocatalysis



*Thank You*