ORGANIC SEMINAR

Taming Hydrogen Bonding in Water

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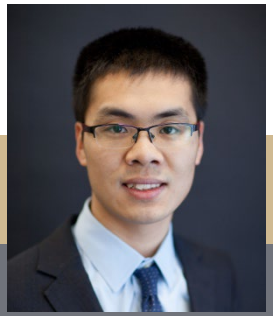
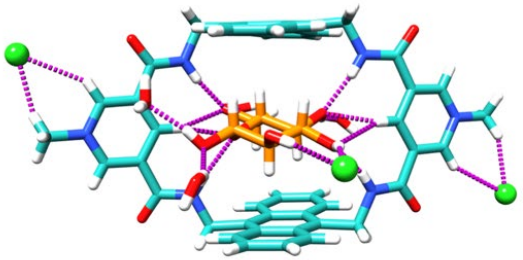
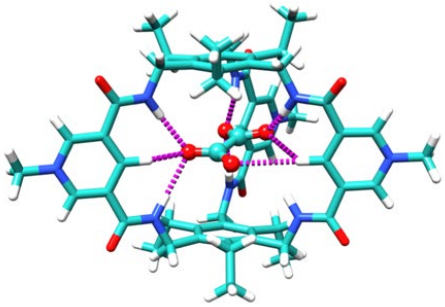


Hydrogen bonding, a weak yet highly directional non-covalent interaction, is fundamental to the structural integrity and functional dynamics of biological macromolecules. It governs critical processes such as DNA replication, enzyme-substrate interactions, transmembrane transport, and cell recognition. While synthetic receptors leveraging hydrogen bonding exhibit strong substrate affinity in organic solvents, their efficacy in water remains a challenge due to the extensive hydrogen-bonding network of water itself, which competes with receptor-substrate interactions and disrupts binding efficacy. Moreover, the synthesis of water-soluble macrocyclic receptors is often complicated by oligomerization and purification difficulties. In this presentation, I will discuss our strategies to overcome these barriers using dynamic imine chemistry and imine-toamide oxidation, enabling the construction of structurally defined water-soluble receptors. By integrating hydrogen bonding functionalities with hydrophobic surfaces or electrostatic binding sites, these systems leverage multiple non-covalent interactions to revalidate hydrogen bonding in aqueous environments, thereby enhancing binding affinity and selectivity for hydrophilic substrates such as carbohydrates and anions. I will also highlight our recent development of a charge-neutral hydrogen bonding receptor that enables specific phosphate recognition in water. These findings provide new insights into receptor design, expanding the potential for synthetic molecular recognition in biologically relevant environments.





References

5. Mariscal, A.; Sagal, L.; Doan, C.; Zhai,C.; Liu, D.; Wojtas, L.; Liu, W. Sulfate Recognition in Water via Charge-Assisted Hydrogen Bonding. *Chem. Eur. J.* **2025**, 10.1002/chem.202501400.
4. Zhai, C.; Mariscal, A.; Liu, W.; Molecular Recognition in Water by Synthetic Hydrogen-Bonding Receptors. Trends in Chemistry, **2025**. 7, 70-84.
3. Zhai, C.; Zulueta, E. C.; Mariscal, A.; Xu, C.; Cui, Y.; Wang, X.; Wu, H.; Doan, C.; Wojtas, L.; Zhang, H.; Cai, J.; Ye, L.; Wang, K.; Liu, W. From Small Changes to Big Gains: Pyridinium-Based Tetralactam Macrocycle for Enhanced Sugar Recognition in Water. Chem. Sci. **2024**, 15, 19588-19598.
2. Xu, C.; Tran, Q.; Liu, D.; Zhai, C.; Wojtas, L.; Liu, W. Charge-Assisted Hydrogen Bonding in A Bicyclic Amide Cage: An Effective Approach to Anion Recognition and Catalysis in Water. Chem. Sci. **2024**, 15, 16040-16049.
1. Zhai, C.; Xu, C.; Cui, Y.; Wojtas, L.; Liu, W. Dynamic Approach to Synthetic Lectin for Glucose with Boosted Binding Affinity through C−H Hydrogen Bonds. *Chem. Eru. J.* **2023**, *29* (32), e202300524.

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