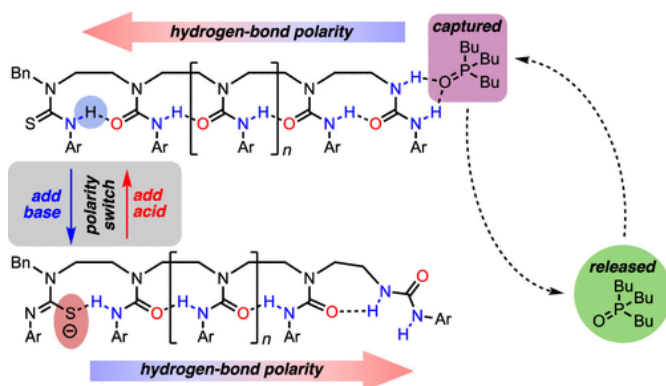


Reversible capture and release of a ligand mediated by a long-range relayed polarity switch in a urea oligomer

Steven M. Wales, David T. J. Morris and Jonathan Clayden*, JACS 2022

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Who are the corresponding authors and what are their research areas?

The corresponding author is Jonathan Clayden. He is an organic chemist. His work is rooted in synthesis and stereochemistry. His research spread over asymmetric synthesis, atropisomeric compounds and dynamic molecular foldamers for information and communication devices.

What is the main claim of the article?

Main claim: This is the first example of a synthetic molecule working as a communication device *via* intramolecular hydrogen bonding interactions. This artificial structure can reversibly and remotely trigger a chemical response, allowing repeated cycles (up to 4 cycles).

Relevance: This kind of structures are commonly seen in nature and biological systems (i.e. membrane proteins). This molecule can control binding at a distance, leveraging intra/intermolecular hydrogen bonding. While previously this effect was used to control optical properties (*Chem* 2021), here the network controls a self-assembly process. In a broad view, such control has some aspects in common with co-conformational changes observed in interlocked molecules, as well as transmembrane transduction systems.

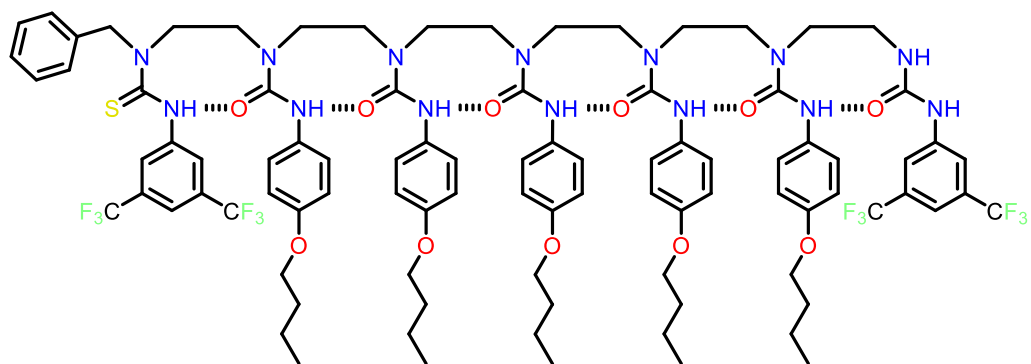
How is it demonstrated?

Demonstration: The main demonstration of the capture/release mechanism is proofed by $^1\text{H-NMR}$ and $^{31}\text{P-NMR}$.

What are the typical experimental conditions?

Capture-and-Release Cycles with thiourea-based compound are carried out with the following conditions

- Solution of $\text{Bu}_3\text{P=O}$ (2.0 mM in CD_2Cl_2 , 500 μL , 1.0 μmol , 1.0 equiv)
- Thiourea-based compound (obtained after 7 synthetic steps) (5.0 μmol , 5.0 equiv), shown in the [Figure](#) below.



- ^{31}P -NMR external standard (sealed capillary tube) containing $\text{Ph}_3\text{P}=\text{O}$ (150 mM in CD_2Cl_2)
- Solution of $t\text{-BuN}=\text{P}(\text{NMe}_2)_3$ (100 μL , 5.0 μmol , 5.0 equiv) in CD_2Cl_2 used as a base to deprotonate the hydrogen in the thiourea moiety
- Solution of $[4\text{-Cl-pyH}]^+[\text{BAR}^{\text{F}_4}]^-$ (4.89 mg, 5.0 μmol , 5.0 equiv) in CD_2Cl_2 used as acid to re-protonate the thiourea moiety

The process of sequential addition of $t\text{-BuN}=\text{P}(\text{NMe}_2)_3$ and $[4\text{-Cl-pyH}]^+[\text{BAR}^{\text{F}_4}]^-$ (and each time recording the ^1H and $^{31}\text{P}\{^1\text{H}\}$ -NMR spectra) was repeated three more times to perform the cycles.

After every addition, N_2 is bubbled inside the NMR tube until the solvent level reaches a mark reference of 500 μL , to study the system always at a constant concentration of 2 mM.

Which are the key related papers?

Morris et al., A molecular communication channel consisting of a single reversible chain of hydrogen bonds in a conformationally flexible oligomer, *Chem* **2021**, 7, 2460–2472, <https://doi.org/10.1016/j.chempr.2021.06.022>

- Previously, the same group studied the switching in the H-bond polarity of a similar oligoureia molecule. *Via* repeated acid-base inputs, a conformational change in the whole system can be produced. This global change was studied by ^1H -NMR and UV-Vis spectroscopy.

Nowick, J.S. et al., Triurea Derivatives of diethylenetriamine as potential templates for the formation of artificial β -sheets. *J. Am. Chem. Soc.* **1996**, 118, 1066–1072, <https://doi.org/10.1021/ja9536072>

- Ethylene-bridged oligoureias explored by Nowick's group, used as artificial β -sheets.

Additional comments, including additional elements of interest

Comments: Some aspects might have been pointed out. For example, the reason of changing the oligoureia molecule and going from pyridine/pyridinium terminal moiety – used in the previous *Chem* **2021** – to the thiourea moiety used in this work. Also, the use of a specific salt $[4\text{-Cl-pyH}]^+[\text{BAR}^{\text{F}_4}]^-$ instead of *e.g.* more common HBF_4 .

Apart from this, the paper is very well written. The experiments are on point and well explained and each of them is supported by meticulous and detailed experimental procedure.

This work paves the way to the use of molecular communication devices in the design of artificial muscles or in on/off catalytic systems.