Strapped Calix[4]pyrroles for the Transmembrane Transport of Anions

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Calix[4]pyrrole plays a pivotal role in anion recognition chemistry owing to its unique structure comprising four pyrrole units linked by methylene bridges. This framework facilitates selective anion binding through four hydrogen-bond donors and cation complexation within the bowl-shaped cavity.[1] Recent advancements in the field include further functionalisation with straps and walls featuring additional binding motifs between the *meso*-positions that enhance ion binding affinity and the preorganization of the calix[4]pyrrole core. These modifications have shown very promising results in the field of transmembrane transport, such as tuneable ion selectivity and various possible transport mechanisms.[2]

In 2023, our group reported a bisurea-strapped calix[4]pyrrole **1** as the first synthetic phosphate transporter, overcoming the high hydration energy barrier to effectively transport phosphate across the lipid bilayer.[3] Building on this previous work, a series of strapped calix[4]pyrroles with varying receptor properties (i.e., cavity size and the number of hydrogen-bond donors) has been synthesised to address the following research questions: First, how do the subtle changes in the design of the receptor impact chloride binding and transport activity? Second, how does transport selectivity trend for chloride changes across the series relative to other anions of different size, shape, and hydration energies (i.e., NO_3^-, Br^-, I^-, ClO_4^-)? Macrocyclic receptors are well known for their preorganization and size-selective binding and transport behaviour, and in certain cases they can overcome the Hofmeister bias.[4] Herein, we present the transport activity and selectivity trends in the strapped calix[4]pyrrole systems.

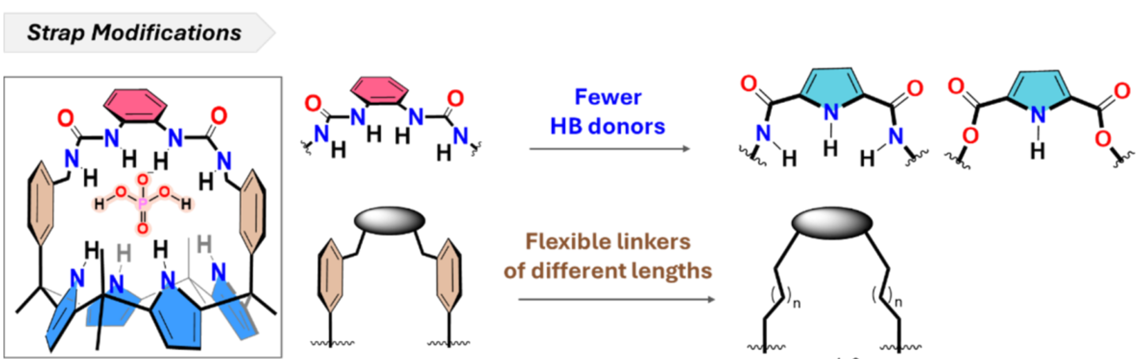

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Figure 1. Schematic of the structural modifications introduced to the design of transporter **1.**

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