

A Model to Study Intramolecular π - π Stacking Interactions

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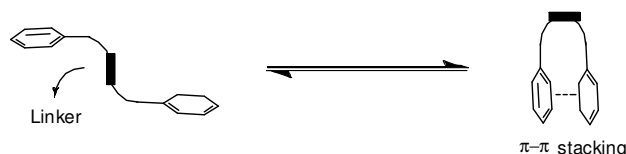
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INTRODUCTION

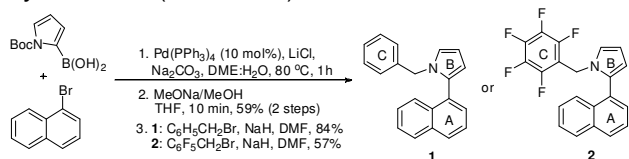
Nature has evolved enzymes as effective catalysts in biological systems. The activity of these macromolecules is governed by a variety of non-covalent interactions.¹ In particular, interactions involving aromatic units play an important role in the behavior of not only biological but also chemical systems.² In order to better understand this phenomena, designing chemical models to study these interactions is meaningful. Scheme 1 illustrates a general system containing 2 aromatic units connected by a "linker". Depending on the nature of the aromatic moieties and the "linker", the rings could be π - π stacked or not.



Scheme 1. Two possible conformations for the system.

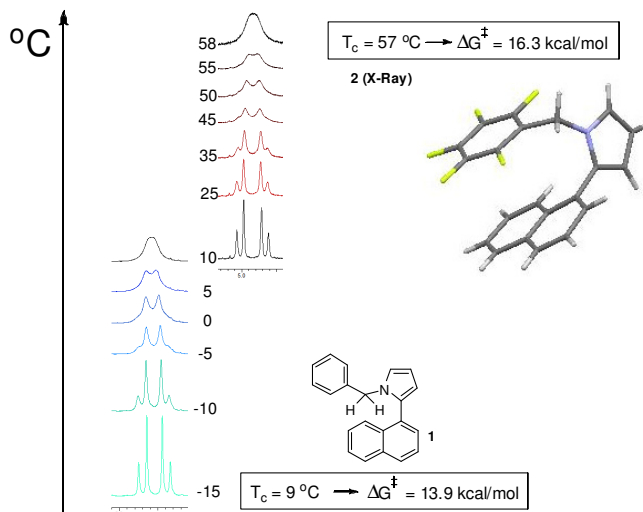
RESULTS AND DISCUSSION

The model we decided to explore consists of a biaryl structure containing 3 aromatic units. The heteroaromatic ring B is the "linker" and rings A and C can π - π stack intramolecularly. To explore the viability of this interaction, compounds **1** and **2** were synthesized (Scheme 2).



Scheme 2. Synthesis of compounds **1** and **2**.

Surprisingly, ¹H NMR of **2** showed an AB quartet at 4.92 ppm, suggesting a diastereotopic environment for the methylene protons. This result allows for the measurement of the barrier to rotation of the biaryl bonds using the coalescence method² (Scheme 3). Considering that compounds **1** and **2** are isosteric, this difference in the barrier to rotation relies mainly on electronic factors. This means that there is a stabilization of 2.4 kcal/mol for compound **2**, most likely due to the well-known ability of perfluoroarene moieties to π - π stack.²



Scheme 3. Variable-Temperature ¹H NMR of **1** and **2** and barriers to rotation.

In addition, **2** is a solid and its X-Ray crystallographic analysis shows that the perfluorobenzyl and naphthalene rings are parallel. The A- and B-rings are perpendicular with a dihedral angle at 88° in the solid state. Also, the A- and C-rings are π -stacked with a distance of 3.26 Å. Interestingly, this is closer than the interplane distance of 3.4 Å between C₆H₆ and C₆F₆ in the well-known co-crystal.² Our work in this area will be presented.

CONCLUSION

An effective system was designed to study intramolecular π - π stacking interactions. New derivatives are currently prepared in order to increase the π - π stacking energy and understand the factors that control this system.

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