‘Substituent Effects on The BOAT Conformation of Six Membered Rings’

by

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stereochemistry: six membered ring systems.

Dedicated to My

Beloved Grandfather

Late. Sh. Rattan Chand Biala

Certificate

This is to certify that the thesis entitled **"Substituent Effects On The "BOAT" Conformation Of Six Membered Rings"** being submitted by Mr. Kapil Sharma to the Indian Institute of Technology, Delhi for the award of Doctor of Philosophy is a record of bonafide research work carried out by him. Mr. Kapil Sharma has worked under my guidance and supervision and has fulfilled the requirements for the submission of thesis which to my knowledge has reached the requisite standards.

The results embodied in this thesis have not been submitted in part or full to any other university or institute for the award of any degree / diploma.

15/04/10

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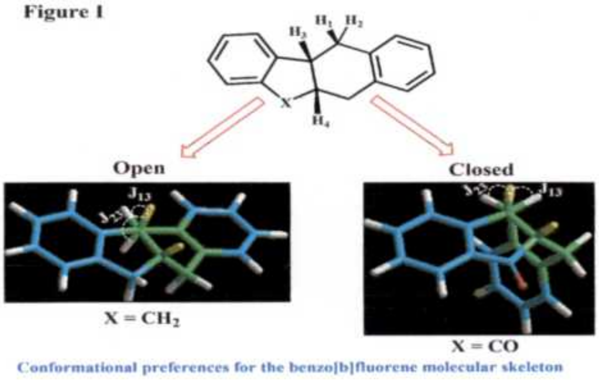
Abstract

The thesis titled ***"Substituents effects on the boat conformation of six membered ring systems"*** is a study of the less well understood phenomenon of boat to boat ring inversion in six membered rings, using experimental and computational methods. A molecular framework capable of displaying this phenomenon is designed. Subsequently, modifications to this skeleton allows the generation of conformational switches and fluorescent metal ion sensors.

Molecular design, chemical synthesis, and structural analysis constitute the three principle components of modern stereochemistry. The transmission of structural and stereochemical information is fundamental to selective chemical processes. The molecular recognition regulating biochemical interactions, all rely on the transfer of such information with great integrity. This makes the field of conformational analysis central to the pursuit of chemical science.

Scheme I: Design and Synthesis of series of molecules based on Tetrahydrobenzofluorene (scaffold analogous to tricyclic natural product 'taiwaniaquinones') skeleton was accomplished. The closed/open boat conformation as suggested by the **computational** results was further revealed, after performing a systematic and deep conformational study using solid state (single crystal X-ray) and solution (1D, 2D NMR) data.

Figure I



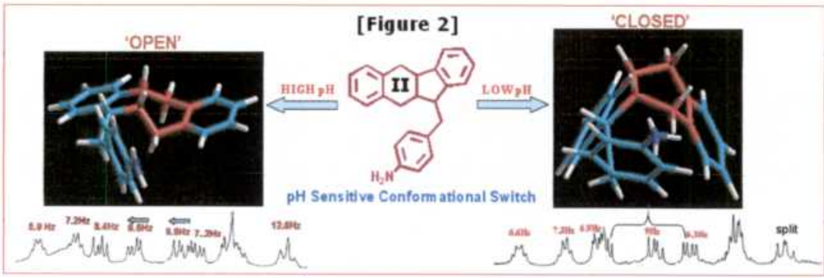
Conformational preferences for the benzo[b]fluorene molecular skeleton

[Where X = O, CH_2, CH_2OH, C=CH-Ph, C=CH-$PhNO_2$, C=CH-$PhNH_2$, C=CH-$PhNH_3^+$, CH-CH_2-$PhNH_2$, CH-CH_2-$PhNH_3^+$].

A distinct preference for one of the two boat conformations [open or closed] can be engineered by changing either the substituent, size of five membered ring or by modulating the polarization over benzene rings flanking the boat cyclohexene based skeleton [Figure I].

The designed cavity size as well as conformational flexibility was later exploited towards the analysis of hazardous metal ion such as lead. The lead ion triggered "***switchable***" conformational change resulting in enhanced ratiometric fluorescence has also been delineated in current research work to yield us a fluorescent Pb^{2+} selective probe.

Scheme II: After getting encouraged by the previous results, we in second part of our research developed Molecular switches whose conformation can be varied by controlling the pH. For that purpose we designed and synthesized PR amine and a controlled target TR. Furthermore, a selective complex isomerism was also seen for conjugated amine owing to its preorganised U shaped cavity.



In contrast, **TR** amine revealed a boat to boat ring Inversion in presence of pH fluctuations. Hence a novel pH-controlled molecular switch has been devised by exploiting ring inversion, on a very simple looking skeleton [Figure 2].

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