DECLARATION

I, Nirmalangshu Chakraborty, bearing Registration Number Ph.D/457/2007 dated

01/05/2007, hereby declare that the subject matter of the thesis entitled

"CHIRALITY IN ACHIRAL BENT-SHAPED MOLECULE" SYNTHESIS

AND CHARACTERIZATION OF BANANA LIQUID CRYSTALS is the

record of work done by me and that the contents of this thesis did not form the basis

for award of any degree to me or anybody else to the best of my knowledge. The

thesis has not been submitted in any other University/Institute.

This thesis is being submitted to Assam University for the degree of Doctor of

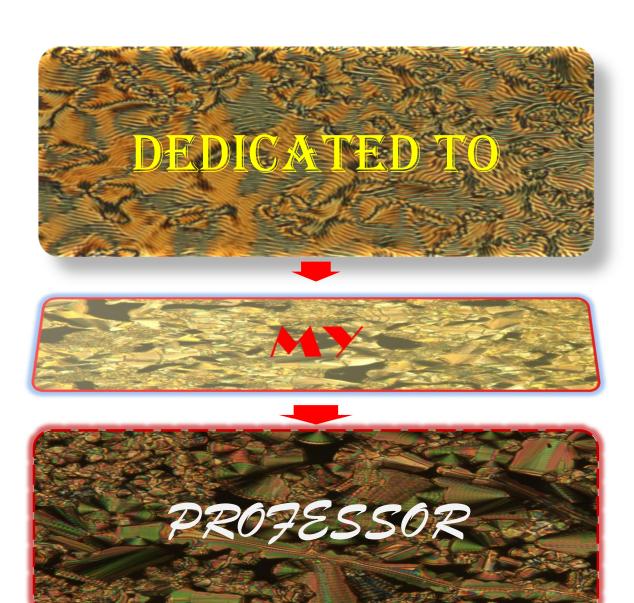
Philosophy in Chemistry.

Nirmalangshu Chakraborty

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Candidate

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Preface

"Imagination is more important than knowledge"

--- Sir Albert Einstein

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The bent shape in an organic molecule promotes layer ordering and hence do not promote mesomorphism unless sufficient anisotropy is manifested in the molecule. For obtaining mesomorphism in bent core compounds, the proper design of ligand is important. The exhibition of nematic and smectic phases by such compounds is experimentally challenging. Due to strong tendency for smectic layering generated by the close packing of the kinked molecules promoted by aromatic core interactions the manifestation of nematic phases among the mesophases in materials of bent core molecules is relatively scarce. Nematic phase is largely realized in five-ring bent core compounds, the derivatives of 1,3-disubstituted phenyl ring with a substituent in 2- or 4- positions. However, reduction of the molecular bent at the apex by the replacement of 1,3substituted 6-membered phenyl ring by a 2,5-substitued 5-membered heterocycles oxadiazole, or thiadiazole or unsymmetrical hockey stick molecules or dimesogens comprised of rod-like and bent units (with a overall reduction in bent angle) yielded the nematic phases at high temperatures above the layered smectic or columnar phases. In this thesis, an extensive study on the design, synthesis and characterisation of novel achiral bent-core molecule based on four benzene rings are presented and the influences of substituents on these materials are highlighted to explore some general structure-property relationships. Additionally, physical studies like stripe periodicity, elastic constants, electro-optical study and dielectric investigation on nematic phases are realized. The organized body of thesis is as follows:

Chapter 1 deals with the general attributes of bent shaped and its associated mesophases. In addition, orientation of molecules in different mesophases of bent core compounds determined by X-ray diffraction and other techniques are described.

Chapter 2, gives the survey about banana-shaped liquid crystals of different molecular structures reported in the literature in quest for chirality followed by proposed plan of research work. This chapter also gives an idea about the current research work in the field of banana shaped liquid crystals.

Chapter 3, describes the elegant synthetic steps towards the successful synthesis of the desired compound. Chemical characterization methods like FT-IR, 1H-NMR, UV-visible, Fluorescence spectroscopy with spectral data of the synthesized compound and procedure involved for the synthesis are mentioned. A brief outline about the experimental set up with working principles and methods involved for studying the phase behaviours and other associated physical properties of liquid crystals are also detailed. These methods include DSC, POM X-ray diffraction measurements, Stripe periodicity and elastic constants.

Chapter 4 (Part A) describes the detailed study of the design, synthesis and characterization of novel 4-ring achiral bent core liquid crystals by POM, DSC and XRD studies. The most elusive nematic phase observed in this type system is discussed elaborately. It is found that nematic mesomorphism can be realized with reduced ring system containing a substituent at the bay position.

Chapter 4(PartB) deals with study of stripe domains, Freedricksz transition and the elastic constants in the nematic phase.

Chapter 4(PartC) describes the conformation of nematic phase by electric field, magnetic field and free standing film studies.

Chapter 5, exhibited the study of examining effect of polar substituents on the central bent core unit in unsymmetrical achiral four ring banana shaped molecule. We observed that a specific substituent (also its polarity and position) in the

central core in such system has a major influence on the banana mesomorphism. The mesomorphic behaviour and emission profile of the compounds are studied.

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"Knowledge can only be got in one way, the way of experience, there is no other way"

--- Swami Vivekananda.

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