INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : **Ph.D.**

Thesis Title: **Design and Syntheses of Liquid Crystalline Perylene Derivatives as Materials for Organic Electronics.**

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Thesis Submitted to the Department/ Center : **Chemistry**

Date of completion of Thesis Viva-Voce Exam : **08.11.2023**

Key words for description of Thesis Work : Liquid Crystal, Perylene Bisimide, Self-assembly, Charge Carrier Mobility

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This thesis, titled 'Design and Synthesis of Liquid Crystalline Perylene Derivatives as Materials for Organic Electronics,' comprises five comprehensive chapters, each contributing to the understanding and exploration of novel liquid crystalline organic materials for various applications. Chapter 1 serves as an introduction to liquid crystals and presents a thorough review of perylene-based discotic liquid crystals. It underscores the significance of perylene's unique properties, such as its strong π-π interactions and self-organizing capabilities, laying the foundation for our subsequent investigations. Additionally, it highlights the advantages of bay-annulated perylene derivatives in comparison to bay-substituted ones, setting the stage for research work discussed in the subsequent chapters. Chapter 2 focuses on the synthesis and characterization of electron-deficient perylene derivatives, and their hetero-atom bay-annulated analogues bearing tri-n-decylphenyl moiety. These compounds exhibit room-temperature columnar liquid crystalline behavior and possess exceptional optical properties, making them promising candidates for organic electronics. Notably, they demonstrate significant potential in the realm of solution-processed host-guest OLEDs as deep red/NIR emitters. Chapter 3 delves into the exploration of PBI and its bay-annulated analogs bearing tri-n-decyloxyphenyl moieties. These compounds exhibit remarkable room temperature columnar phases and high molar extinction coefficients, offering promising prospects for applications in organic solar cells and as non-fullerene acceptors. Their unique ambipolar conductivity behavior sets them apart from typical n-type semiconductors. Chapter 4 introduces a swallowtail modification to lower the clearing point of perylene bisimide and its heteroatom annulated derivatives. These compounds exhibit stable liquid crystalline behavior up to room temperature with low melting points, strong fluorescence, and ambipolar conductivity. Their potential in organic electronics is further highlighted. Chapter 5 addresses the challenge of solubility in the less explored class of perylene bis benzimidazole derivatives (PBs) with expanded aromatic cores. These compounds exhibit wide absorption spectra, elevated LUMO and HOMO levels, reduced band gap, enhanced solution processability, stabilized columnar hexagonal phase up to room-temperature and ambipolar behavior, making them ideal candidates for organic solar cells and unique organic semiconductors.