

Hybrid Subnaphthalocyanines as Building Blocks for Photonic Materials: Synthetic Strategies and Structural Characterization

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Abstract

Hybrid Subnaphthalocyanines incorporating both phthalonitrile and naphthalonitrile units represent an emerging class of macrocycles with tunable photophysical properties intermediate between their symmetric analogues. Despite their promise for photonic applications, these structures remain largely underexplored due to substantial synthetic challenges. This work presents systematic optimization of mixed cyclotrimerization reactions to selectively access hybrid macrocycles. The inherently statistical nature of the reaction generates complex isomeric mixtures, necessitating careful stoichiometric control. Key synthetic challenges addressed include isomer scrambling during cyclotrimerization, difficult chromatographic separations of products with nearly identical polarities, and structural characterization of asymmetric macrocycles using NMR spectroscopy. Comprehensive spectroscopic analysis confirms successful synthesis of the target hybrid structures. This work establishes reproducible synthetic methodologies that provide accessible routes to hybrid subnaphthalocyanines as versatile building blocks for advanced photonic and materials applications.