Functionalized *meso*-tetraarylporphyrins: unlocking pathways to tailored applications

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Tetrapyrrolic macrocycles, such as natural porphyrins and chlorins, are an abundant class of compounds in nature, characterized by unique physicochemical properties and their vital roles in key biological processes, such as respiration, electron transfer, and photosynthesis.

In recent years, porphyrins and related macrocycles have become the focus of extensive research works aimed at developing new compounds/materials for diverse applications. This growing interest is primarily driven by their remarkable optical and physical-chemical properties, which can be finely tuned through structural modifications of the tetrapyrrolic core. The distinctive features make tetrapyrrolic macrocycles highly attractive and versatile compounds, with applications across various fields, including catalysis, water remediation, supramolecular chemistry, medicine, and (chemo)sensing.

The relevance of both natural and synthetic porphyrins in various applications is closely related to their distinctive stability, optical and photophysical properties, conformational flexibility, and chemical versatility, together with their biological relevance. These properties can be finely adjusted by incorporating suitable functionalities either at the inner core or on the periphery of the tetrapyrrolic macrocycle. It is widely recognized that appropriate functionalization at both *meso*- and β-pyrrolic positions plays a crucial role in modulating the optical and redox characteristics, thereby impacting the intended applications. Consequently, the synthesis of appropriately functionalized *meso*-tetraarylporphyrins has been extensively investigated, paving the way for tailored applications in different areas.

This communication outlines synthetic strategies developed in our research group to obtain *meso*- and *beta*-functionalized porphyrin derivatives bearing diverse units. Furthermore, it explores the potential applications of these newly synthesized porphyrin derivatives.