Pyrrolo[3,2-*b*]pyrroles – Electron-Rich Functional Heterocycles

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Recently we have discovered and optimized the first practical synthesis of non-fused pyrrole[3,2-*b*]pyrroles *via* domino reaction of aldehydes, primary amines, and butane-2,3-dione.[1] Six bonds are formed in heretofore unknown tandem process, which gives rise to substituted pyrrole[3,2-*b*]pyrroles – the 'missing link' on the map of aromatic heterocycles. Unparalleled simplicity and versatility of this one-pot reaction, non-chromatographic purification and superb optical properties (including strong violet, blue or green fluorescence both in solution as well as in the solid state), brought these molecules from virtual non-existence to the intensively investigated area functional π-systems. The parent 1,4-dihydro-pyrrolo[3,2-*b*]pyrroles served as building block to construct various π-expanded analogs including nitrogen-embedded buckybowl with inverse Stone–Thrower–Wales topology[2,3] and diindolo[2,3-*b*:2′,3′-*f*]pyrrolo[3,2-*b*]pyrroles. These compounds constitute the most electron-rich ladder-type heteroacenes known to date - E_{HOMO} was located at ca. −4.6 eV. Strongly fluorescent diindolo[2,3-*b*:2′,3′-*f*]pyrrolo[3,2-*b*]pyrroles represent the only existing compounds bearing the pyrrolo[3,2-*b*]pyrrolo[2',3':4,5]pyrrolo[2,3-*d*]pyrrole core.

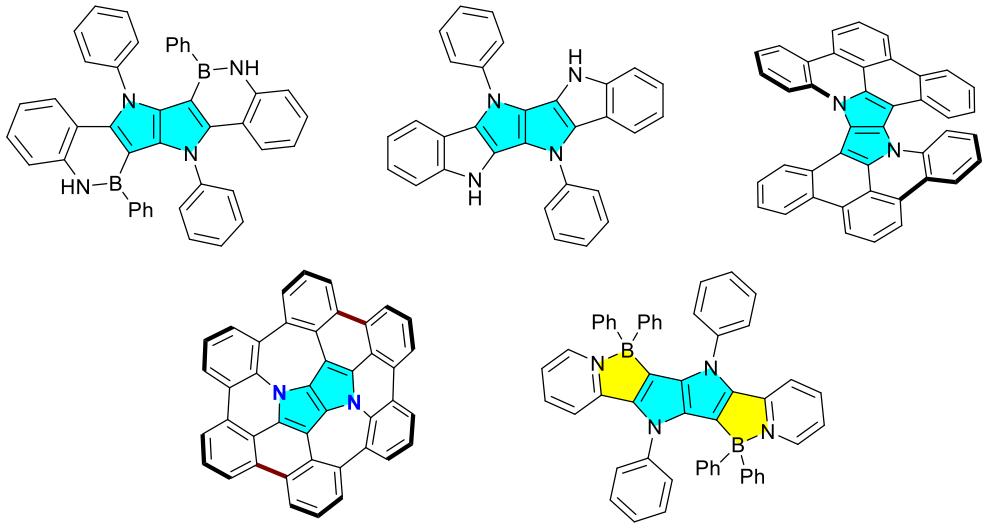

Figure 1. Exemplary architectures based on pyrrolo[3,2-*b*]pyrrole core.

References

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