Project 2.4 Highly emissive, strongly polarized multiple helicenes built from pyrrolo[3,2-*b*]pyrrole scaffolds

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Background:

For many applications of organic semiconductors, planarity is considered a prerequisite. This is largely because key properties (such as a low HOMO–LUMO gap and polarizability) are dependent on strong π-conjugation. Deviation from planarity, however, can give rise to new and exciting electronic, optical, and magnetic properties that are currently unknown or underinvestigated in the field of organic semiconductors, but possess considerable potential. In addition, non-planarity can produce helically-chiral structures, with chiroptical properties. Helical polycyclic aromatic hydrocarbons (PAHs) represent one of the most promising, yet most elusive, classes of π-conjugated molecules. [n]Helicenes, that is, ortho-fused helical PAHs, where n is the number of fused benzene rings, endow characteristic chiroptical properties and dynamic behavior owing to their helical chirality. Although enormous progress has been made in the chemistry of helicenes, there are still numerous challenges, including: (1) Notoriously low fluorescence quantum yields. (2). Shifting the absorption and emission into the far-red and NIR regions has proved impossible based upon the current fused benzenoid helicene structures.

Aim:

The main objective of the proposed research project is to develop synthetic methodology that leads to heretofore unknown, polycyclic, helical, highly polarized molecules possessing pyrrolo[3,2-*b*]pyrrole and diketopyrrolopyrrole as core structural components. It is envisioned that long/multiple, strongly polarized helicenes of this type will possess the previously unobtainable photophysical properties mentioned above such as very high fluorescence quantum yields and deep-red and NIR emission.

Requirements:

MSc in chemistry, specialization – organic chemistry. Good knowledge of English.