Near-infrared (NIR) organic light-emitting devices (OLEDs) in the "century of phot®onics"

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Organic semiconductors still provide a variety of opportunities and challenges for the development of photonics and optoelectronics.Emphasis will be placed on the potential of low-gap organic semiconductors for Near-infrared (NIR) applications.

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1. Introduction

Active-matrix organic light-emitting diodes (AMOLEDs) have now provided (arguably) unparalleled displays for top-of-the-range TVs and smartphones, and have thus undeniably established the potential of conjugated semiconductors for real applications for both PHOTonics and optoelectRONICS. The question arises, however, as to which further contribution organic semiconductors (OS) can provide in the current century.[1].

2. Organic light-emitting diodes (OLEDs) incorporating low-gap materials

In this talk I will present a few examples of our work on light-emitting devices incorporating low-gap materials which emit in the 700-1000 nm spectral range, and that have potential for (nearly) visible light communications (VLCs)[2] as well as for biomedical applications (owing to the semitransparence of biological tissue in such a spectral window).

π-conjugated dyes benefit from a variety of appealing features including (but not limited to) cheap fabrication over large areas, mechanical conformability and biocompatibility (ideal for wearable and skin-integrated technologies), low-weight (e.g. for avionics and space applications), short energy payback times (affording greater sustainability with respect to conventional "inorganic semiconductors"), to name but a few. However, the efficiency of near-infrared conjugated emitters is limited by the so-called energy gap law, [1] in addition to their tendency to form non-emissive aggregates. Singlet-triplet mixing in phosphorescent emitters partially mitigates the problem, although their heavy metal content limits their biocompatibility.

I will therefore present a few examples where the emphasis is placed on fluorescent materials such as derivatives of 4,4-difluoro-4-bora-3a,4a-diaza-s-indacene (BODIPY),[3] diketopyrrolopyrroles (DPPs)[2], or porphyrin oligomers.

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