New perylene diimide derivatives: stable red emission, adjustable property from ACQ to AIE, and good device performance with an EQE value of 4.93%

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PII: S2095-9273(17)30538-8
DOI: https://doi.org/10.1016/j.scib.2017.10.021
Reference: SCIB 256

To appear in: *Science Bulletin*

Received Date: 5 September 2017
Revised Date: 15 October 2017
Accepted Date: 17 October 2017

Please cite this article as: L. Zong, Y. Gong, Y. Yu, Y. Xie, G. Xie, Q. Peng, Q. Li, Z. Li, New perylene diimide derivatives: stable red emission, adjustable property from ACQ to AIE, and good device performance with an EQE value of 4.93%, *Science Bulletin* (2017), doi: https://doi.org/10.1016/j.scib.2017.10.021

Received 5 September, 2017

Revised 15 October, 2017

Accepted 17 October, 2017

New perylene diimide derivatives: stable red emission, adjustable property from ACQ to AIE, and good device performance with an EQE value of 4.93%

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Abstract: Perylene diimide (PDI) derivatives, due to their special opto-electronic property, have been successfully utilized in organic field-effect transistor (OFET), solar cells, and as non-fullerene acceptor and others, while few cases in organic light-emitting diodes (OLEDs). In this work, six perylene bisimide-based red emitters, *N,N*'-bis(2-decyltetradecyl)-1-([1,1':3',1''-terphenyl]-5'-yl))perylene-3,4,9,10-diimide (**STPH**), *N,N*'-bis(2-decyltetradecyl)-1,7-bis([1,1':3',1''-terphenyl]-5'-yl))perylene-3,4,9,10-diimide (**DTPH**), *N,N*'-bis(2-decyltetradecyl)-1-(5'-phenyl-[1,1':3',1''-terphenyl]-4-yl)perylene-3,4,9,10-diimide (**STRPH**), *N,N*'-bis(2-decyltetradecyl)-1,7-bis(5'-phenyl-[1,1':3',1''-terphenyl]-4-yl)perylene-3,4,9,10-diimide (**DTRPH**), *N,N*'-bis(2-decyltetradecyl)-1-(4-(2,2-diphenylvinyl)phenyl)perylene-3,4,9,10-diimide (**STTPE**) and *N,N*'-bis(2-decyltetradecyl)-1,7-bis(4-(2,2-diphenylvinyl)phenyl)perylene-3,4,9,10-diimide (**DTTPE**), with the excellent chemical, thermal and photo-chemical stability, are synthesized through the convenient Suzuki coupling reaction, in which, the fluorescent properties can be modified easily from ACQ to AIE by just simply changing the bulky volume of the introduced aromatic substituents. After being fabricated into organic light-emitting diodes, **STRPH** exhibits the best performance with the maximum luminescence, power efficiency, current efficiency and external quantum efficiency of 1,948 cd m^{-2}, 2.04 lm W^{-1}, 5.85 cd A^{-1}, 4.93% at Commission Internationale de L'Eclairage (CIE) coordinates of (0.56, 0.34), as the result of the high efficient energy transfer and good energy match achieved in the device.