Spectral and photophysical characterization of donor π -acceptor arylthienyl- 
and bithienyl-benzothiazole derivatives in solution and solid state

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Abstract

A comprehensive study has been made in solution at room temperature (293 
K), low temperature (77 K) and in thin films (Zeonex matrixes) of the spectral 
and photophysical properties of six arylthienyl and bithienyl-benzothiazole 
derivatives functionalized with different donor groups. Similar experiments have 
been carried out with two related precursors (containing the arylthienyl and aryl-
bithienyl conjugated systems), and results are compared. Singlet-singlet and 
triplet-triplet absorption spectra, emission spectra together with lifetimes and 
quantum yields have been obtained, and from these data for all the radiative 
and non-radiative processes determined, providing information on the dominant 
radiative and radiationless decay processes. The arylthienyl-benzothiazole 
derivatives show high fluorescence quantum yields (\(\Phi_F\)) with negligible internal 
conversion (\(\Phi_{IC}\)), whereas the bithienyl-benzothiazoles display lower but still 
significant \(\Phi_F\) values, but now radiationless processes (\(\Phi_{IC}\) and \(\Phi_{ISC}\)) are 
competitive. The experimental results obtained for the bithienyl-benzothiazole 
derivatives strongly suggest that, these fluorophores could be used on the 
design of more efficient OLEDs since it minimises internal conversion, and 
significantly reduces triplet state formation. A comparison with the analogous 
oligothiophenes is made. Singlet oxygen yields were also determined and the 
triplet energy transfer to \(\cdot\)O, to produce \(\cdot\)O, was found to be highly efficient with 
values of \(S'_\Delta(=\Phi_{\Delta}/\Phi_T)\) varying from 0.4-1.