Synthesis of Quaterrylene-based Dyes as possible NIR sensitizers in Dye-Sensitized Solar Cells

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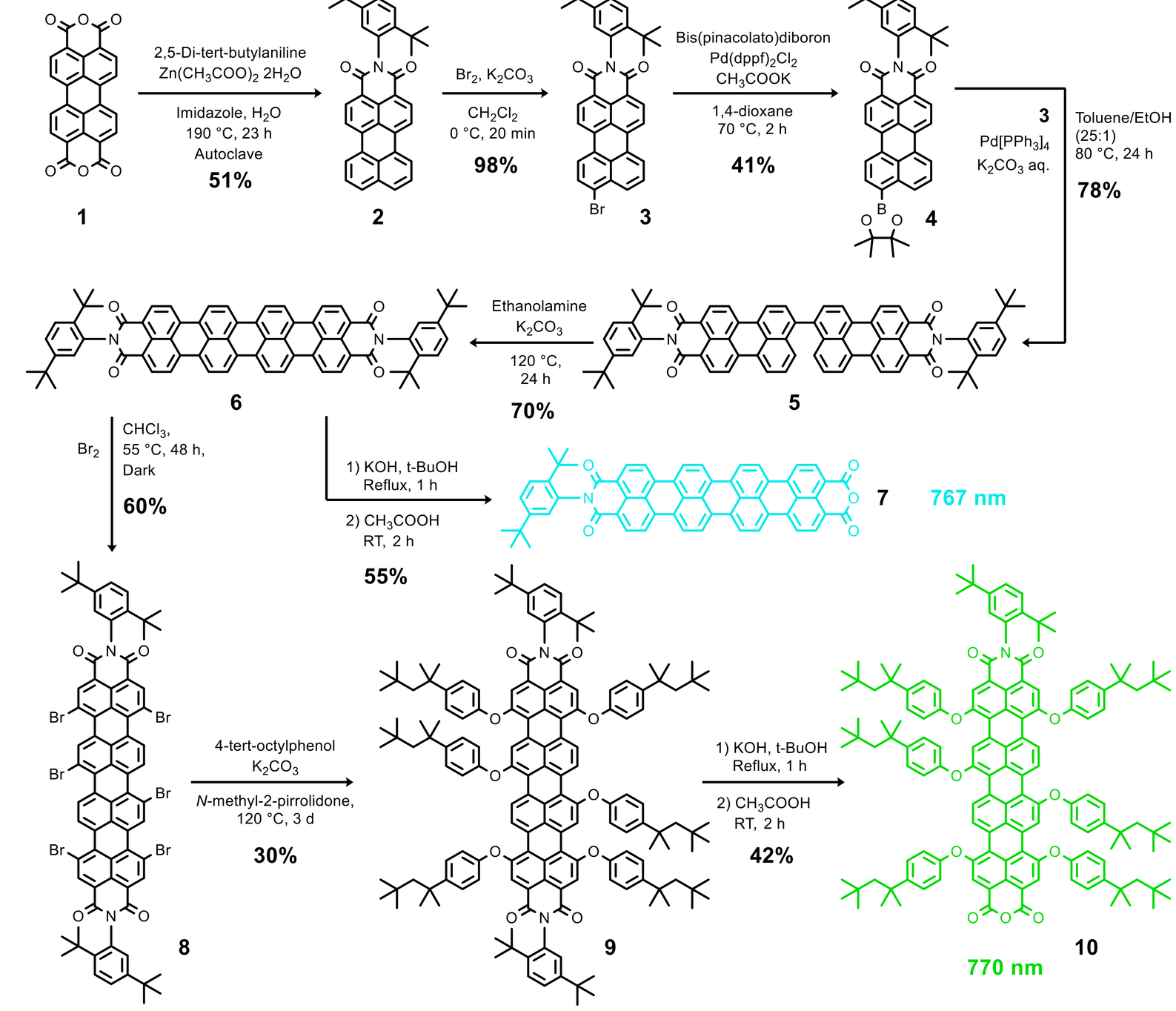
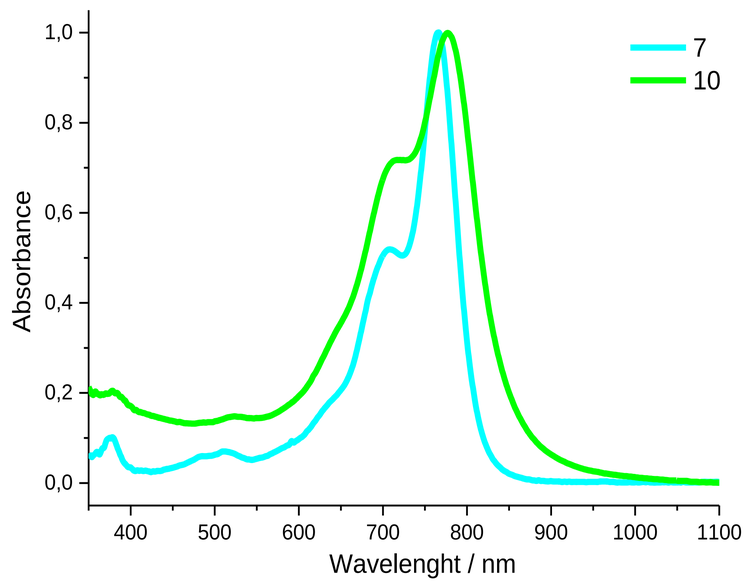
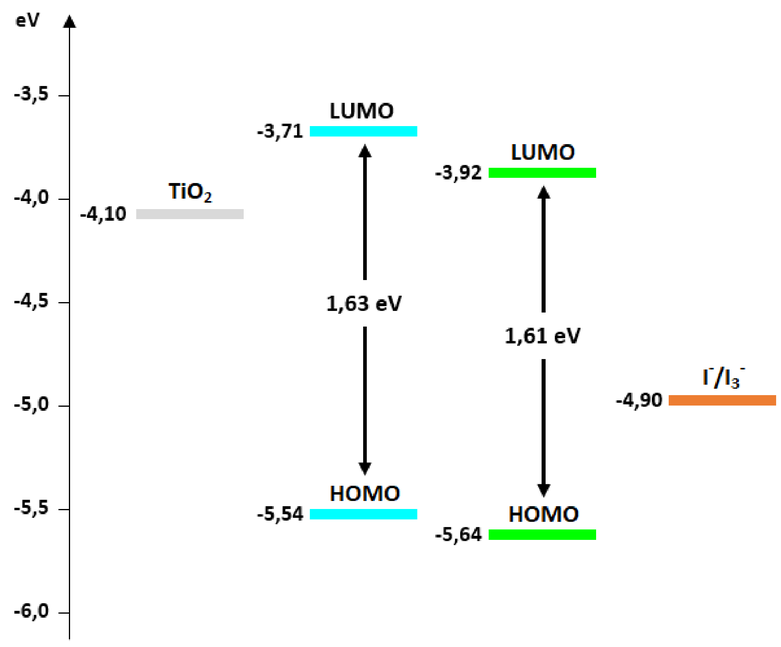
Photovoltaic cells based on semiconductor technology are, nowadays, the most efficient and easily available systems for solar energy conversion. Dye-Sensitized Solar Cells (DSSCs) are very promising owing to low production costs, transparency and ability to harvest diffused light.[1] Building Integrated PhotoVoltaics (BIPV) based on DSSC are an emerging application to make DSSC more attractive in the energy production field. An innovative and powerful approach resides on the implementation of colourless DSSCs based on NIR sensitizers such as polymethine and rylene dyes.[2,3] In this work, we present the synthesis of two quaterrylene dyes to evaluate their application as NIR-sensitizers in DSSCs.

Quaterrylene dyes: synthesis and characterization

The quaterrylene dyes are synthetized following a three stage strategy: construction of the rylene scaffold, functionalization of the core and, finally, hydrolysis to release the anhydride group as anchoring moiety. Tert-octylphenol substituents are chosen to improve the processability alongside to hinder the π-π stacking during the dye-loading on the TiO_2 surface.







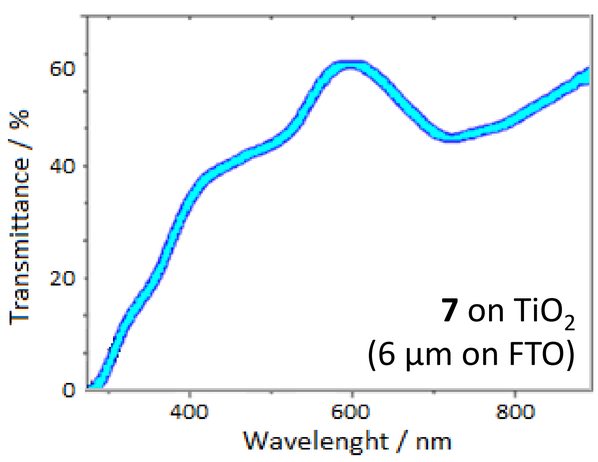
Both dyes have optimal HOMO and LUMO energy levels that guarantee a proper electron injection and dye-regeneration process.

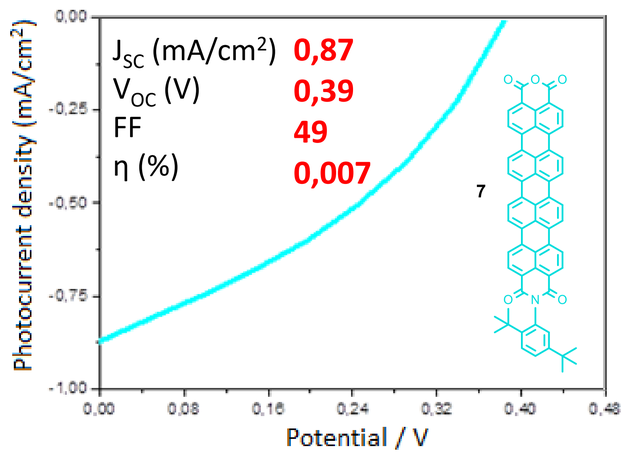
Preliminary study in DSSC

Dye **7** was applied in DSSC to explore the dye-loading procedure on TiO_2 surface. As expected, the lack of substituents on the rylene affect the performance of the device alongside the dye's properties: (i) poor solubility in organic solvents, (ii) low efficiency due to the excited-state decay process promoted by the stacked dye's molecules.

Dye **10** overcomes the solubility and processability issues and we will expect that the bulky substituents will lower the π-π stacking, improving the device's performance.

Dye 10 is still under investigation…





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References

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