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Electron donor-acceptor substituted porphyrinic macrocycles: a new class of sensitizers for solar cells

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Introduction

Nature has chosen plant chlorophylls as antennae to harvest light for the conversion of solar energy. Inspired by this natural process, and also by the need of having non-renewable energy sources, scientists are looking for porphyrinic structures to be efficiently incorporated as sensitizers in dye-sensitized solar cells (DSSCs).[1]

The most recent results show that the use of a push-pull framework or porphyrinic derivatives bearing fused rings are good strategies to accomplish such purpose.[2,3]

Taking that in mind, we designed and synthesized electron aryl donor-acceptor 2-(4-carboxyarylamino)porphyrins **1** and the corresponding cyclized derivatives **2**.

To evaluate their potential application in DSSC devices, the spectral, electrochemical, and photovoltaic properties of these compounds are being investigated.

Results and discussion

2-(4-Carboxyarylamino)porphyrins **1** (**Figure 1**) were obtained through the arylation of 2-amino-5,10,15,20-tetraphenylporphyrin with halogenated arylformate methyl esters under Buchwald conditions, followed by a demetalation/metalation sequence and alkaline hydrolysis.

Aiming to reach sensitizers with broad absorption bands in Vis-IR region, the mentioned ester porphyrinic derivatives were submitted to a thermal oxidative cyclization. Then, by ester alkaline hydrolysis, the anchoring carboxylic groups present in **2** (**Figure 1**) were obtained.

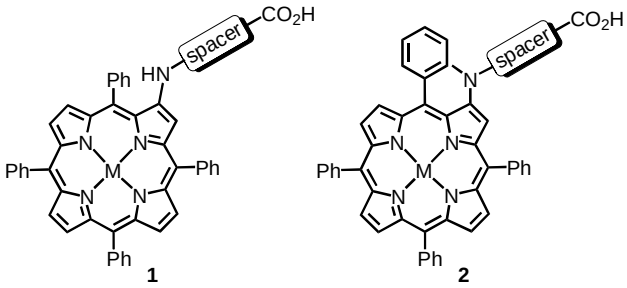

Figure 1. Structure of 2-(4-carboxyarylamino) porphyrins **1** and porphyrinic derivatives bearing fused rings **2**.

The optical and electrochemical studies (to calculate the LUMO and HOMO levels) have revealed the potentiality of the new compounds for being considered as dyes in DSSC devices. The incorporation of one of the 2-(4-carboxyarylamino)porphyrin series **1** already showed a power conversion efficiency value of about 30 % in relation with the value achieved by the more conventional reference Ru(II)-sensitizer N719; the I^-/I_3^- redox couple was used for the dye's regeneration.[4]

Conclusions

2-(4-Carboxyarylamino)porphyrins **1** and the corresponding cyclized derivatives **2** were obtained through accessible methodologies.

One of the simpler 2-(4-carboxyarylamino) porphyrins **1** already generates a reasonable power conversion efficiency in DSSC devices.

In future, by using derivatives **2**, it is aimed to reach sensitizers with improved photovoltaic performances.

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