

Lab rotation on fabrication and optimisation of organic photovoltaic devices

Objectives

- Gain experience in the use of a clean room to prepare thin films.
- Gain experience in cleaning device substrates.
- To gain experience in using a glove-box and a metals evaporator.
- To understand the complexities in the optimisation of a polymer photovoltaic device efficiency.
- To use a solar simulator to test the efficiency of polymer OPV devices by recording JV scans under AM1.5 illumination.

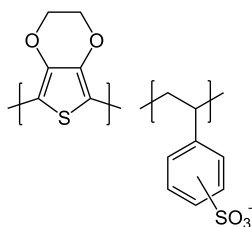
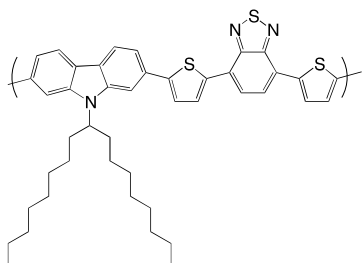
Experiments

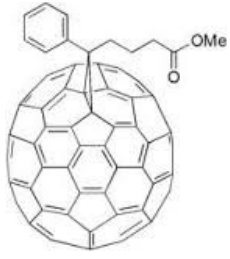
You will perform an optimisation of the thickness of that active layer of an organic photovoltaic (OPV) device. The material system that you will use is based on the donor co-polymer PCDTBT, and the fullerene acceptor PC₇₀BM. Optimised devices based on these materials fabricated in Sheffield have an efficiency of around 5.5%.

You will be assisted in your experiments by Mr. Chris Bracher. Chris will meet you in the 2nd year lab at 09:00. Device fabrication will be undertaken in lab C21. Make sure you read the safety documentation available before you start work.

You have been supplied with a pre-mixed solution of PCDTBT:PC₇₀BM in a chlorobenzene solution at a blend ratio of 1:4. Your objective is to fabricate an OPV device based on the structure ITO / PEDOT:PSS / PCDTBT:PC₇₀BM / Ca / Al. Here, the PCDTBT:PC₇₀BM is the active layer in which light is absorbed and charges generated. PEDOT:PSS is a hole-extraction layer, matching the HOMO level of the PCDTBT in the active layer with the ITO work-function. Both the PEDOT:PSS and PCDTBT:PC₇₀BM are deposited by spin-coating. You should explore the thickness of the PCDTBT:PC₇₀BM by choosing a range of spin-speeds. You can measure the thickness of control films using a Dektak surface profiler.

Once you have fabricated your devices, record their key device metrics (power conversion efficiency, short circuit current, open circuit voltage and fill-factor) using an AM 1.5 solar simulator. From your device data, determine whether you have achieved an optimised PCE. Perform an analysis on your data to determine the statistical significance of your results.





PCDTBT

PC₇₀BM

PEDOT:PSS