

Progress Report

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1. Purpose of the project

The p-n junctions in inorganic semiconductors are exploited in a wide range of today's electronic applications. Thus, the organic p-n junctions may have potential in some applications such as organic photovoltaic cells. Pursuing this purpose, project focuses on the fabrication of organic solar cell base on heterojunction between single crystals pentacene/perfluoropentacene and examination its photovoltaic characteristics.

2. Experiments

a. Single crystals solar cell

Using single crystals pentacene and PFP which is mentioned in previous reports, I made samples with structure show in figure 1 and then measure its I-V characteristics with and without light exposure.

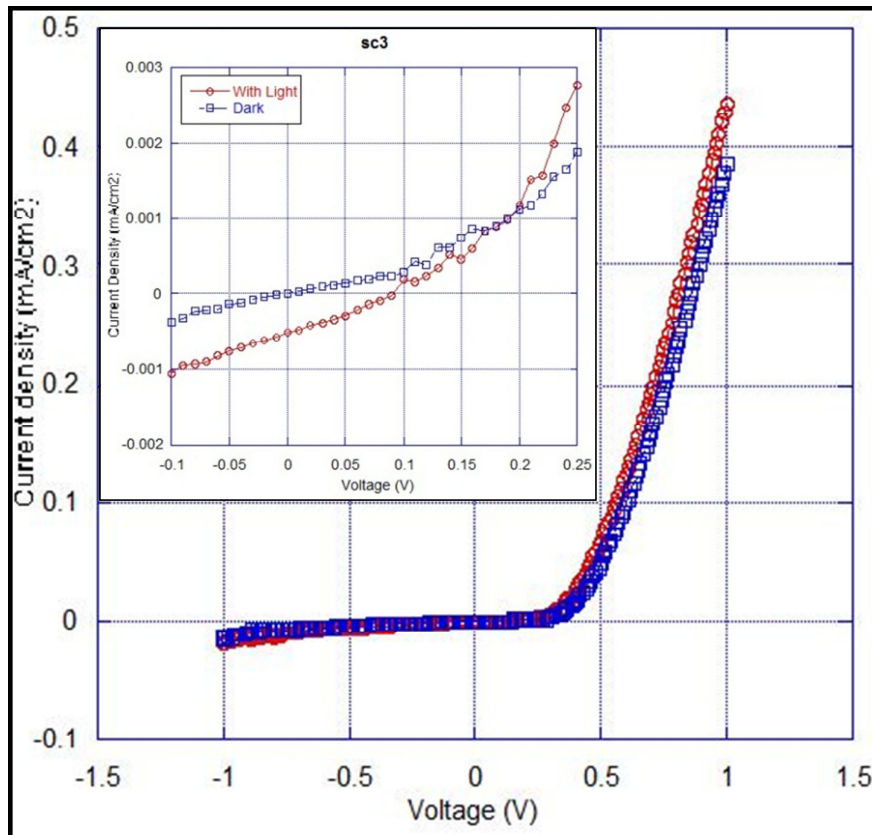


Figure 1: Sample structure (left) and image of PFP single crystal edge on top of the pentacene single crystal (right).

I have prepared 3 samples and measured their I-V characteristic, which show clearly photovoltaic effect. However, only the third sample I measured under standard light source (AM 1.5, 1000W/m²).

The efficiency of 0.000014% is very low, which may due to:

- Bad interface between single crystals. It is very difficult to make large interface without folds of single crystals → defect at the interface.
- Intrinsic of materials: absorption and energy level alignment.
- Low electric conductivity of c-direction of PEN and PFP single crystals (maybe the most important, which leads to very low current density). Addition, the thickness of these single crystals is still quite high (few hundreds of nm).



Thickness of single crystal layers ~ 200-500nm
 Area ~ 0.5 mm² (mask area)
 FF= 30.2%
 $V_{oc} = 0.091V$
 $I_{sc} = 0.0005mA/cm^2$
 Efficiency = 0.000014%

Figure 2: I-V characteristic under AM 1.5

b. P-n junction of PEN/PFP

I made sample which have structure like figure 3, the silver paste is attached at the interface of PEN/PFP single crystals.

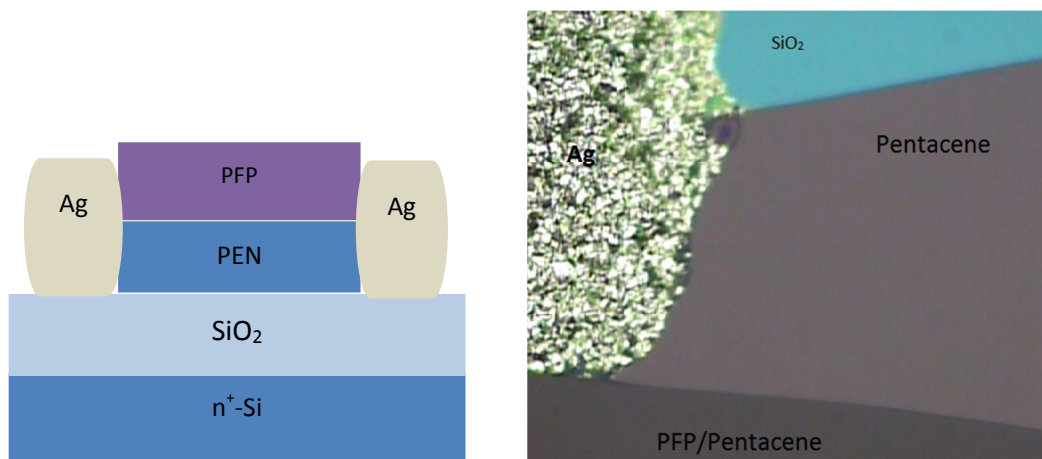


Figure 3: p-n junction of PEN/PFP single crystals

However, I just obtained the FET characteristic of pentacene (mobility ~1cm²/Vs), and did not show any high conductivity of the interface.

3. My future plan

I will try to make the p-n junction in the CuPc and F₁₆CuPc single crystals, which is reported to have the charge transfer in thin film. (Wang, Jun, Haibo Wang, Xuanjun Yan, Haichao Huang, and Donghang Yan. "Organic heterojunction and its application for double channel field-effect transistors." *Applied Physics Letters* 87, no. 9 (2005): 093507)