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. Capacitance- Voltage measurement of pentacene/perfluoropentacene heterojunction

My experiment setup

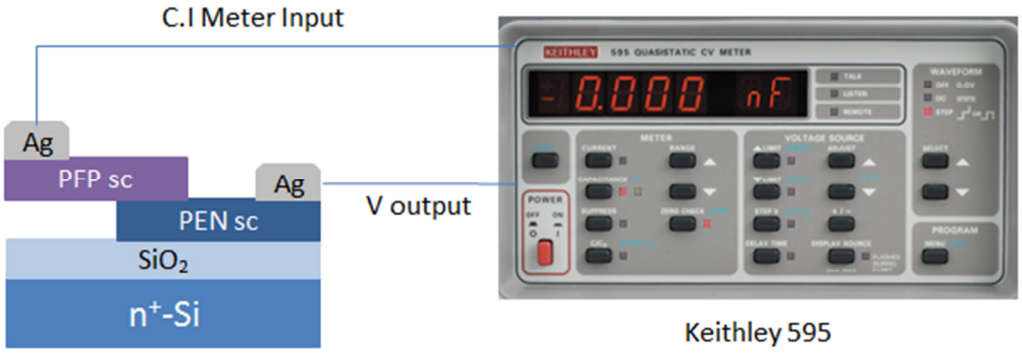
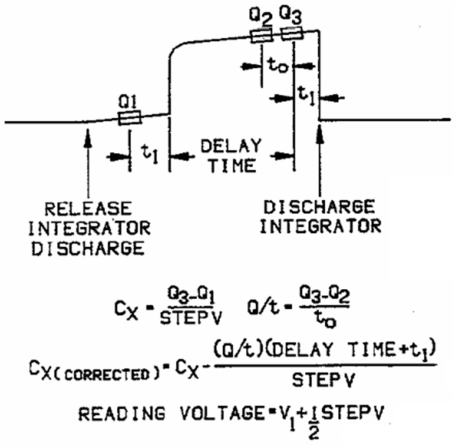


Figure 1: Schematic illustration of samples and experiment setup.

The reason for using this configuration due to the large resistance compares to the ITO/PEN/PFP/Ag setup in which leak current is excess limit of the Keithley 595. However, I think the quasistatic C-V method is not suitable because some reasons:

- The leak current still exist and the correction part (Q/t*(delaytime+t_1/STEP V)) is one-order larger than the capacitance itself ($Cx_{corrected}$).
- Besides, there are some parasitic capacitances in sample, which cause two plateaus in C-V curve. Assume that there are two parasitic capacitances, one is serial (C_1) and another is parallel (C_2) with the capacitance of the depletion region (C_{dr}). When the applied voltage is larger than the build-in voltage (V_{bi}), the capacitance of the depletion region reaches infinity. Thus, the V_{bi} can be determined at voltage that the C-V curve approaches the limit (plateau at the high voltage). But, the V_{bi} in most samples is



larger than 1V, true value should be around 0.2V.

- The C-V curves are different from sample to sample (the shape is similar), even from every measurement in the same sample. Moreover, different swept direction also gives different result.

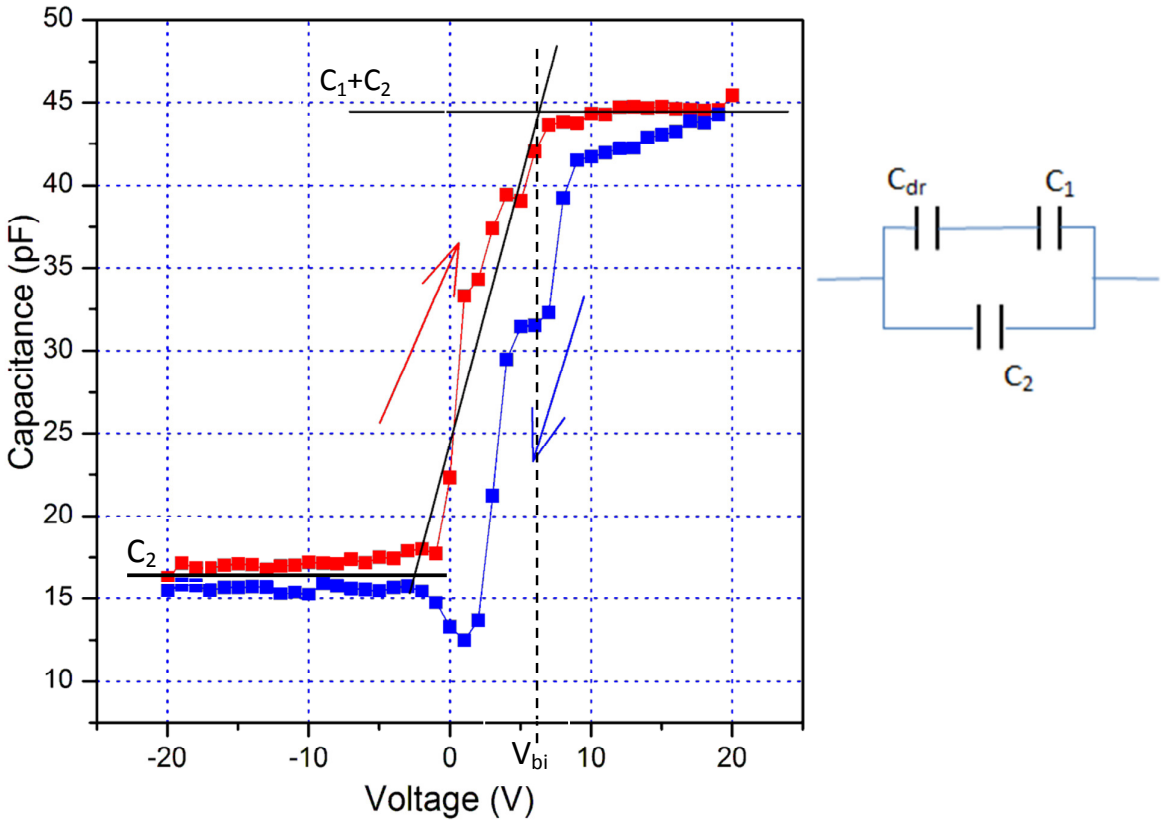


Figure 2: C-V measurement of PEN/PFP sample with different swept directions and the way I determined V_{bi}.

In conclusion, it seems that when laminating the PEN and PFP, the depletion region is formed which demonstrated by the rectification I-V curve and shape of the C-V curve. However, I cannot use the C-V measurement results to clarify the depletion width and V_{bi}.

b. AFM measurement of PEN and PFP single crystals

By using AFM, I checked the thickness of the single crystals pentacene and PFP in range of 200-300nm, which I typically used in my experiment. Besides, the roughness of pen sc surface is very small.

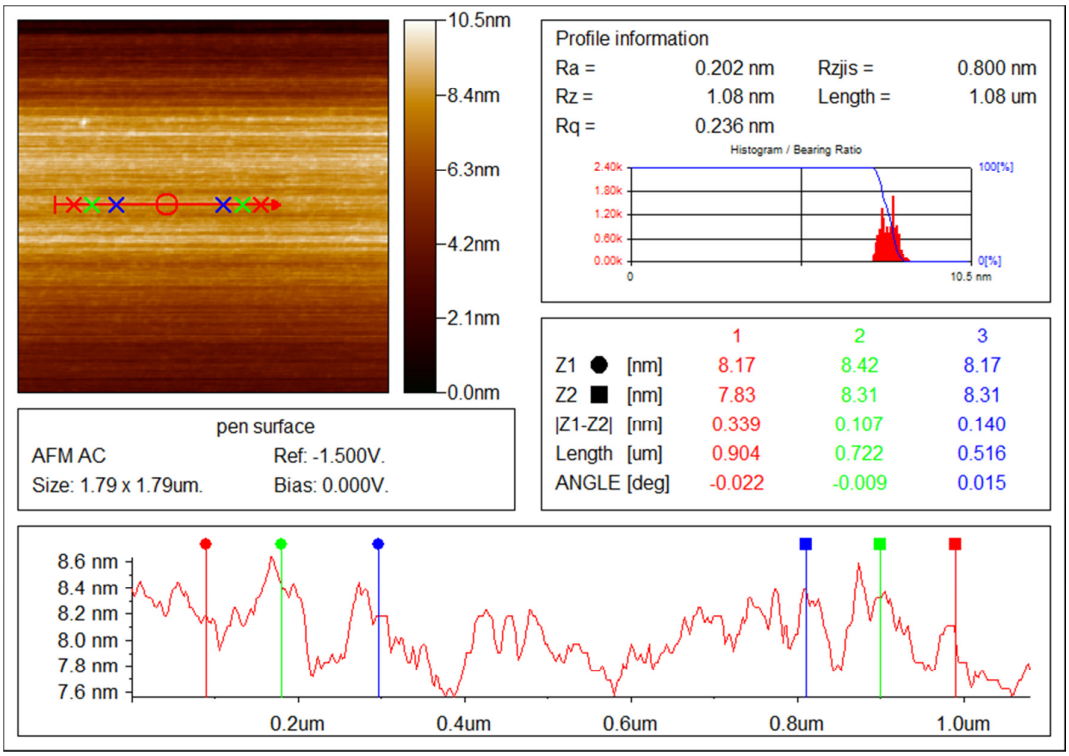


Figure 3: AFM image of pentacene single crystals interface.

c. FET characteristic of PEN/PFP

In order to complete the data for conferences, I measured the FET characteristic of PEN/PFP heterojunction. My goal is to achieve the ambipolar behavior of this heterojunction but up to now, I cannot. Maybe the thickness of 200-300nm is so high, so I can only obtain the FET of pentacene.