

Effect of thermal annealing on the structure of the small molecule (electro-donor) DRCN5T: tunneling spectroscopies (STS) analysis

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ABSTRACT: Thermal annealing (TA) can lead to very different morphologies that directly impact the organic solar cells (OSCs) efficiency. This temperature treatment could improve bulk morphology, which reduce charge carrier recombination and, therefore, improving the photovoltaic performance of bulk heterojunction (BHJ). Here, very thin solid films (~ 300 pm) of DRCN5T:[70]PCBM blend, were analyzed through scanning tunneling microscopy (STM) and scanning tunneling spectroscopy (STS). DRCN5T is an electro-donor compound used in the OSCs active film, which reach $\sim 10\%$ of power conversion efficiency. These very thin solid films exhibit a worm-like pattern without thermal annealing (amorphous behavior), however after applying TA at 120°C , the small molecule crystallizes: its structural geometry become a well-defined organized one.

INTRODUCTION

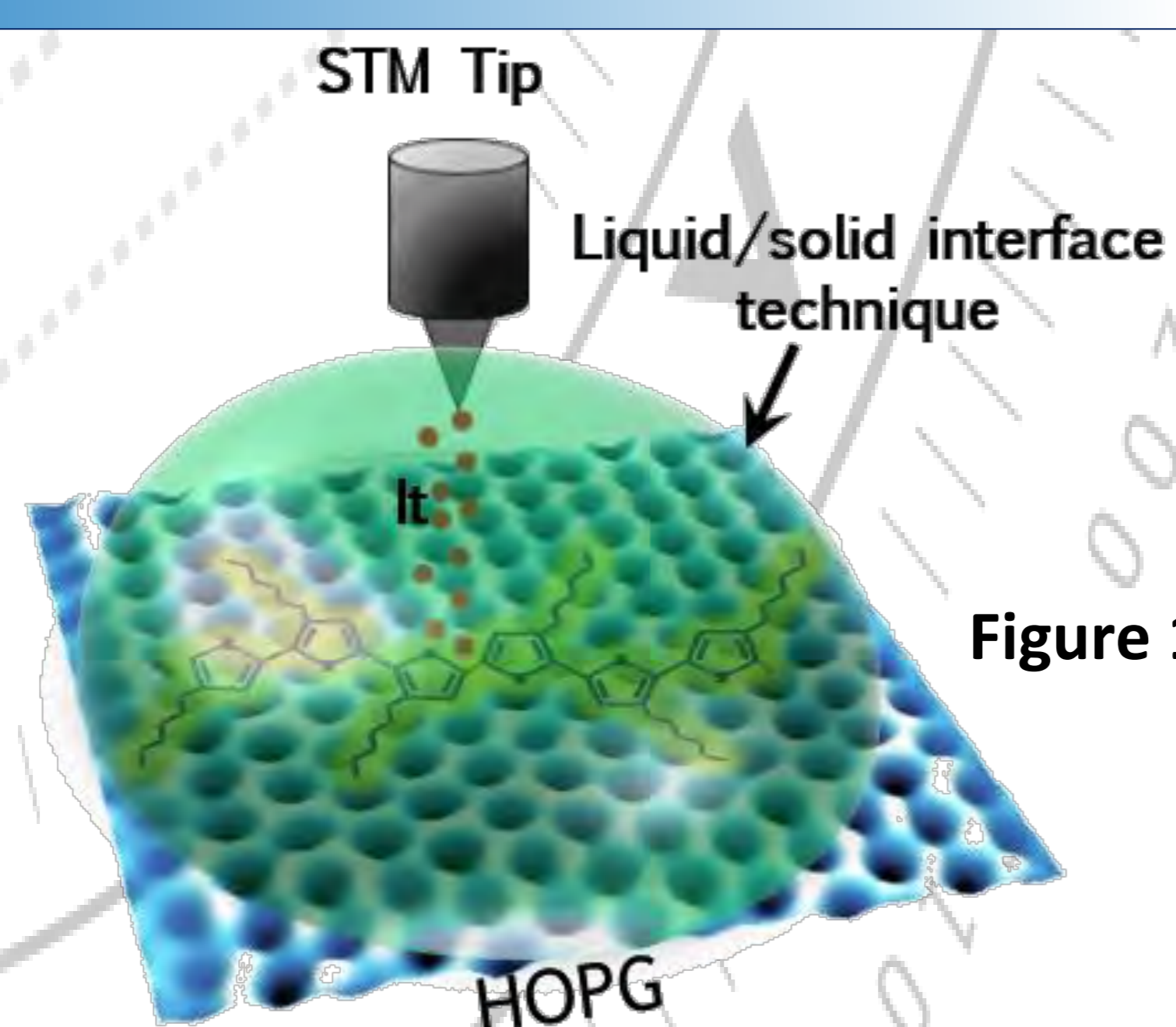


Figure 1. STM principle.

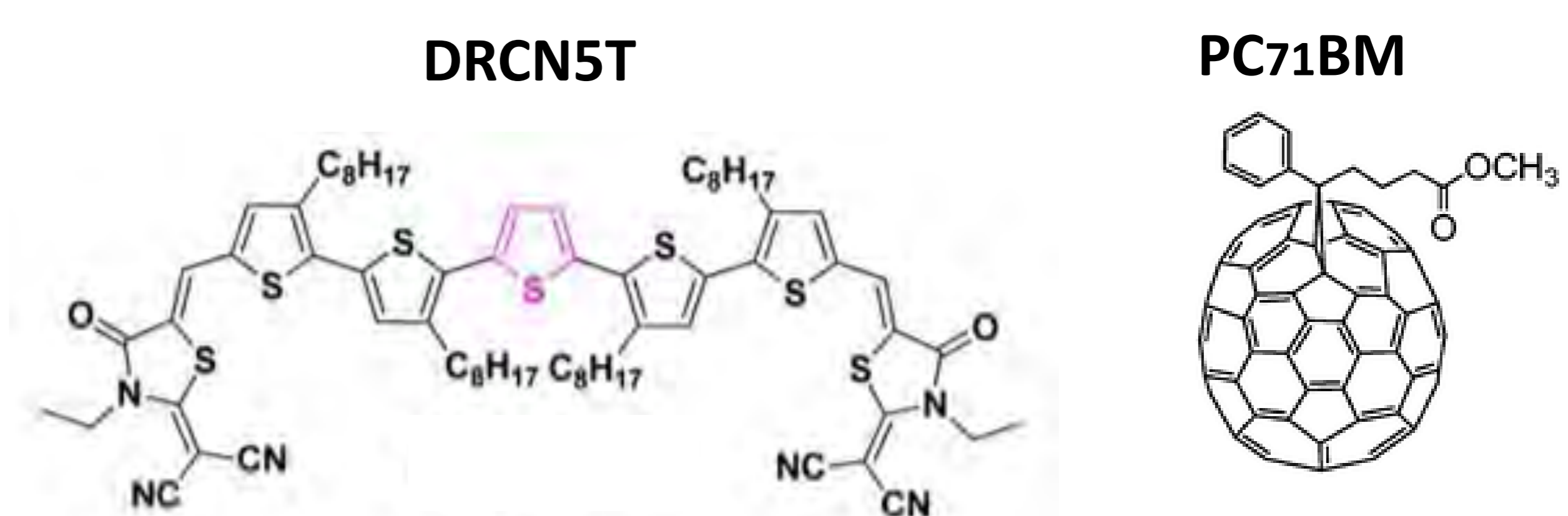


Figure 2. Chemical compounds used in this work.

EXPERIMENTAL

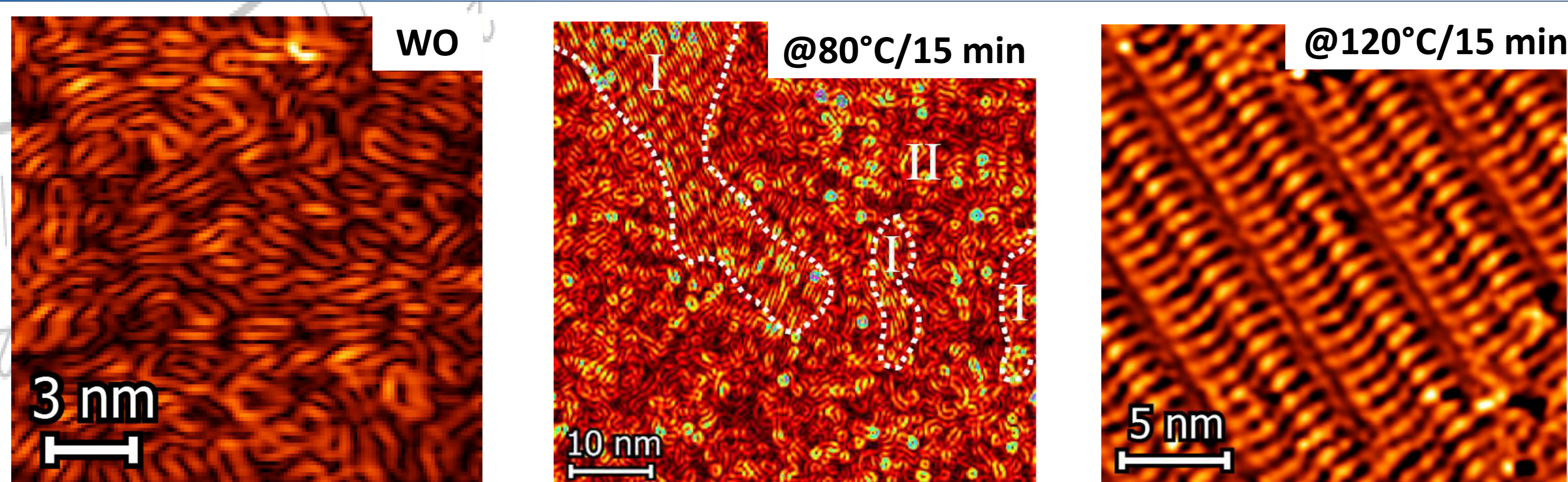


Figure 3. STM of DRCN5T at different temperatures.

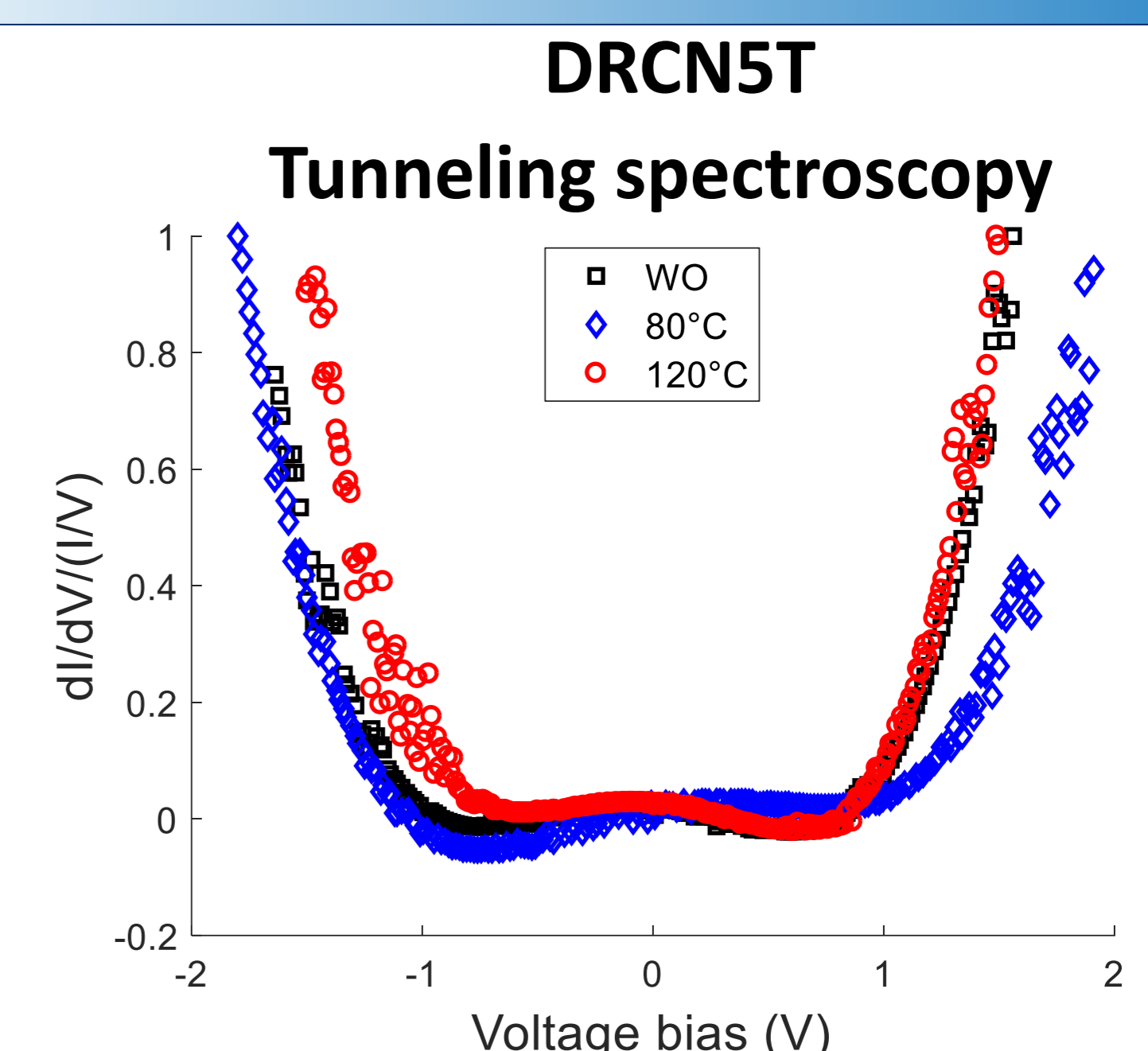


Figure 4. Variations of Local density of states (LDOS) band gaps.

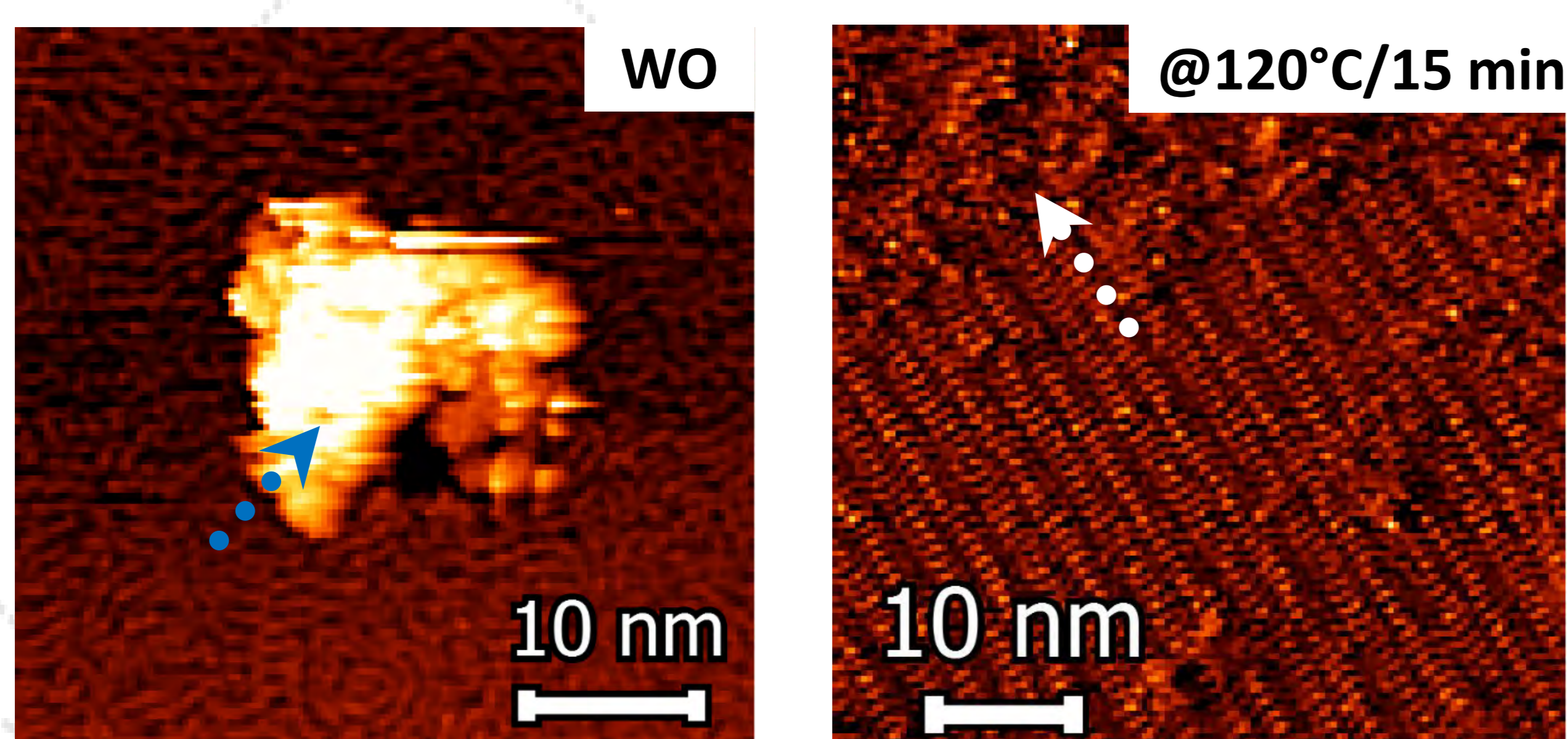


Figure 5. STM images of DRCN5T:[70]PCBM blend.

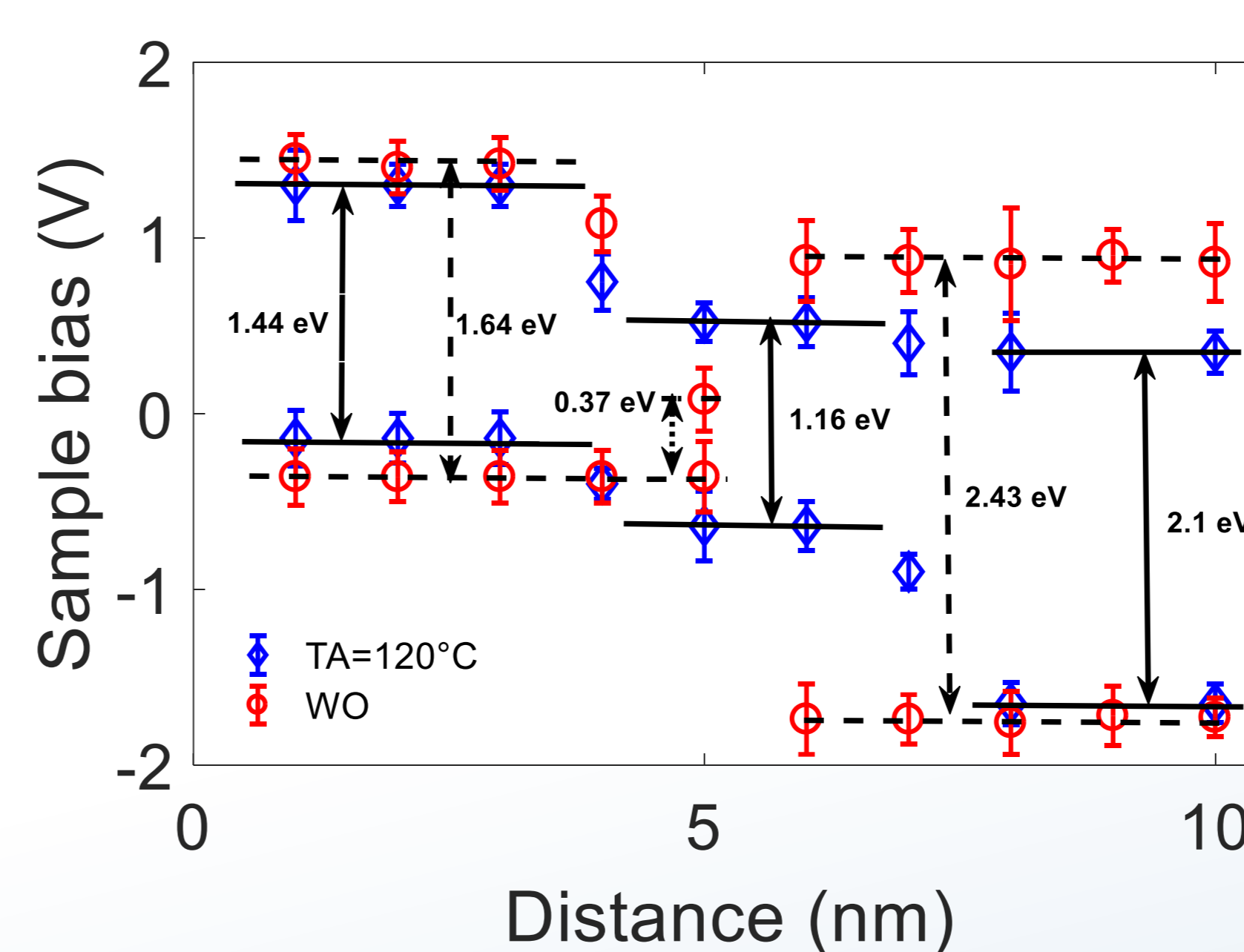


Figure 6. Energetic levels across the DRCN5T:[70]PCBM interface.

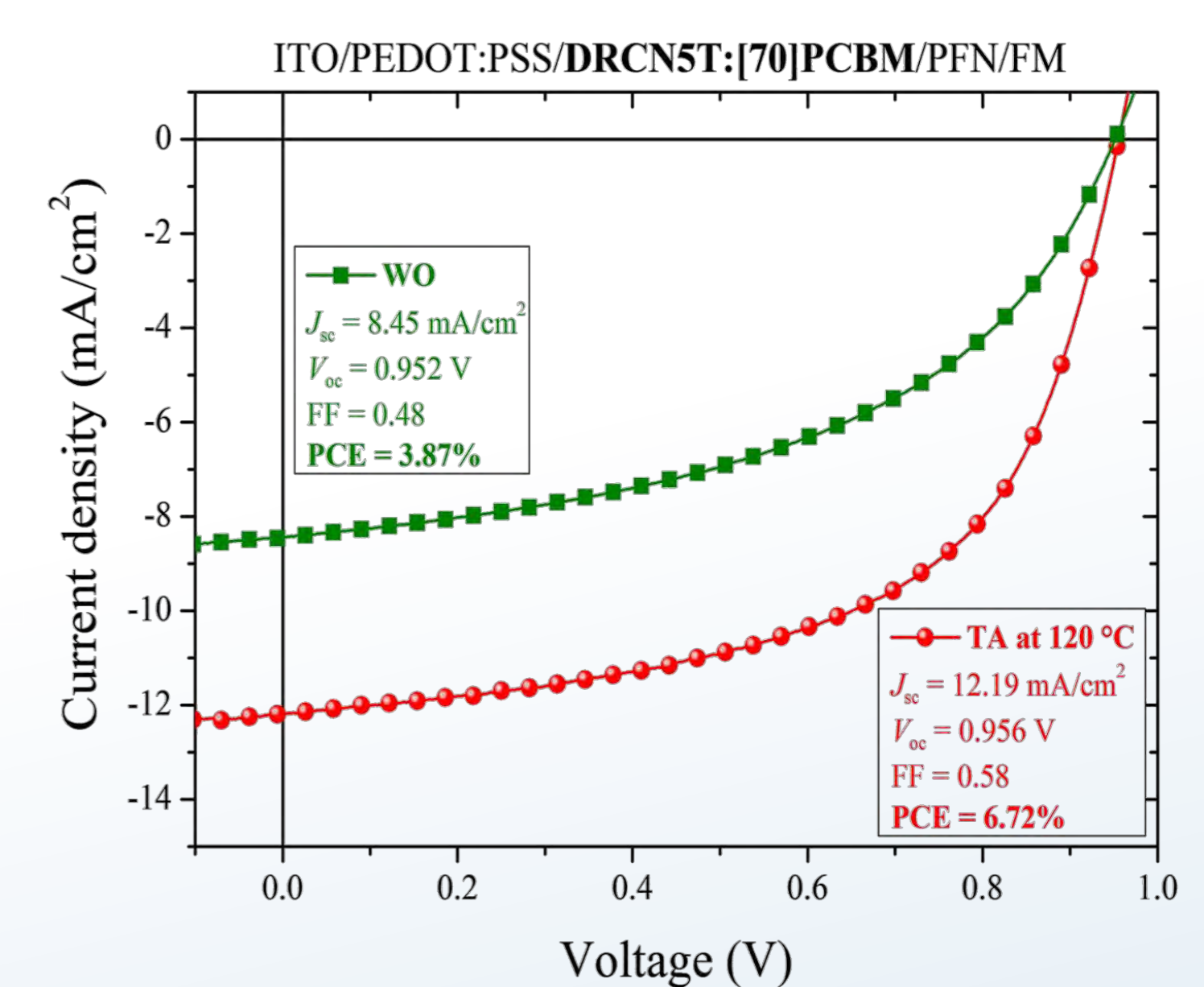


Figure 7. J-V characteristics of the fabricated OSCs without any treatment and with TA at 120°C .

*WO = Without thermal annealing

CONCLUSIONS

The impact of thermal annealing results in better ordering of the small molecule DRCN5T and also in the DRCN5T:[70]PCBM blend. Correlating morphology and energetic characteristics with device performance, STM and STS measurements suggest that an energy cascade is necessary to improve the performance of SM-OSCs

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