Role of Surface Charge Dynamics in UV-Induced Hydrophilic Flipping of Polysulfone Thin Films

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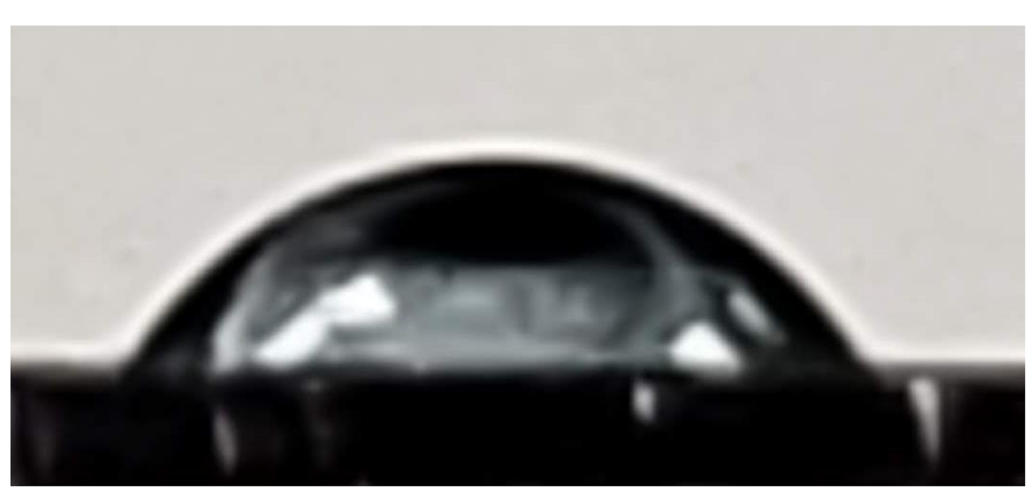
Abstract Reportedly, hydrophobic surfaces of polysulfone (PSu) thin films become hydrophilic following exposure to UV radiation and it can affect PSu novel applications in microfluidics and biophysics. Fundamental mechanisms behind this effect remain unknown. To elucidate them, in our work we study surface charge transport employing surface photovoltage (SPV) on thin PSu polysulfone films spin-cast on silicon substrates. Since exposure of PSu even to an ambient UV light could affect the surface properties we ran SPV spectroscopy as well as SPV transient experiments on both as-received samples fabricated in darkness and UV-irradiated films of varying and controllable thicknesses. We report on the comparison of the SPV response in the as-deposited and UV-irradiated polysulfone samples.

Introduction

- Polysulfone is naturally hyrophobic
- UV light causes surface to flip from hydrophobic to hydrophilic
- Investigating surface optoelectronic behavior via surface photovoltage (SPV) could reveal the origins of this phenomenon
- Understanding this behavior is applicable in nano-fluidics
- Phenomenon applicable in "water diode"

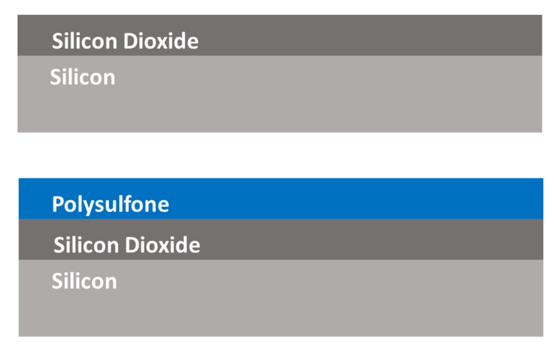
Hydrophobic flipping

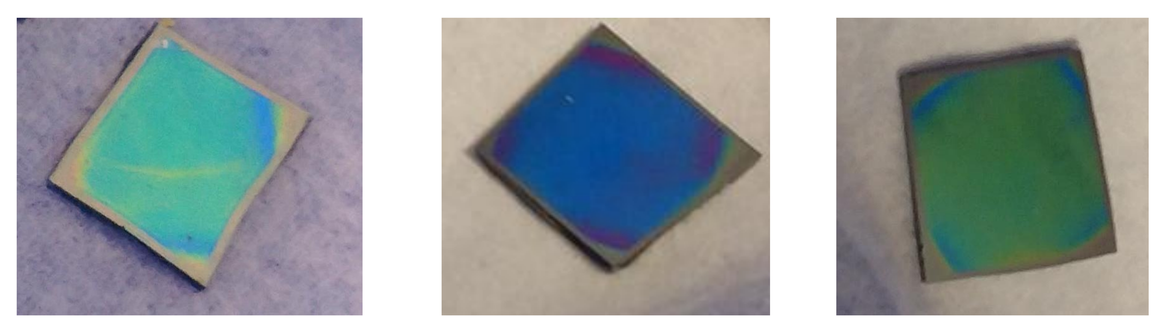
Images below are of a 20 microliter droplet of DI water on a polysulfone film before and after exposure to UV light via a Hg lamp



Thin film interfaces affect SPV

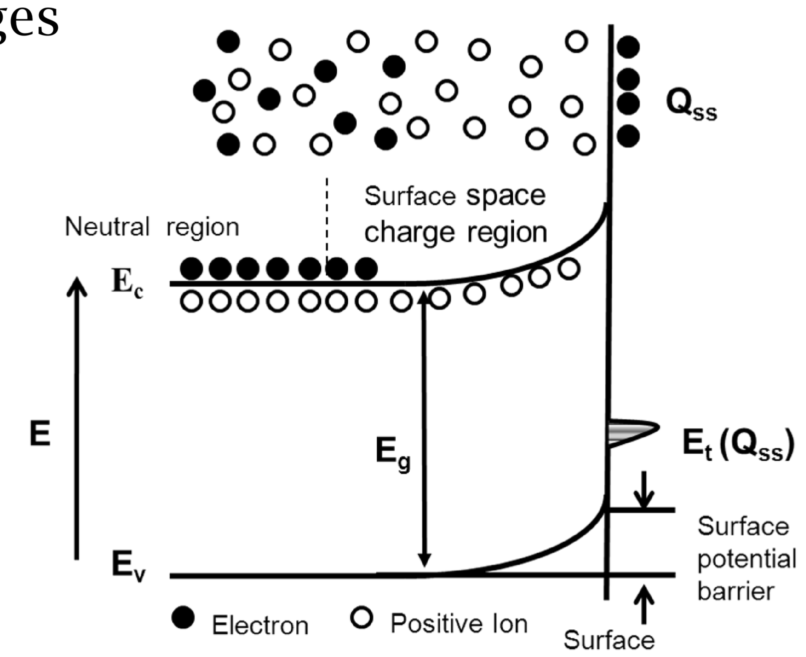
- To study polysulfone on a sudbstrate, we vary thickness of polysulfone films
- This allows us to isolate polysulfone signal from interfaces introduced by substrate





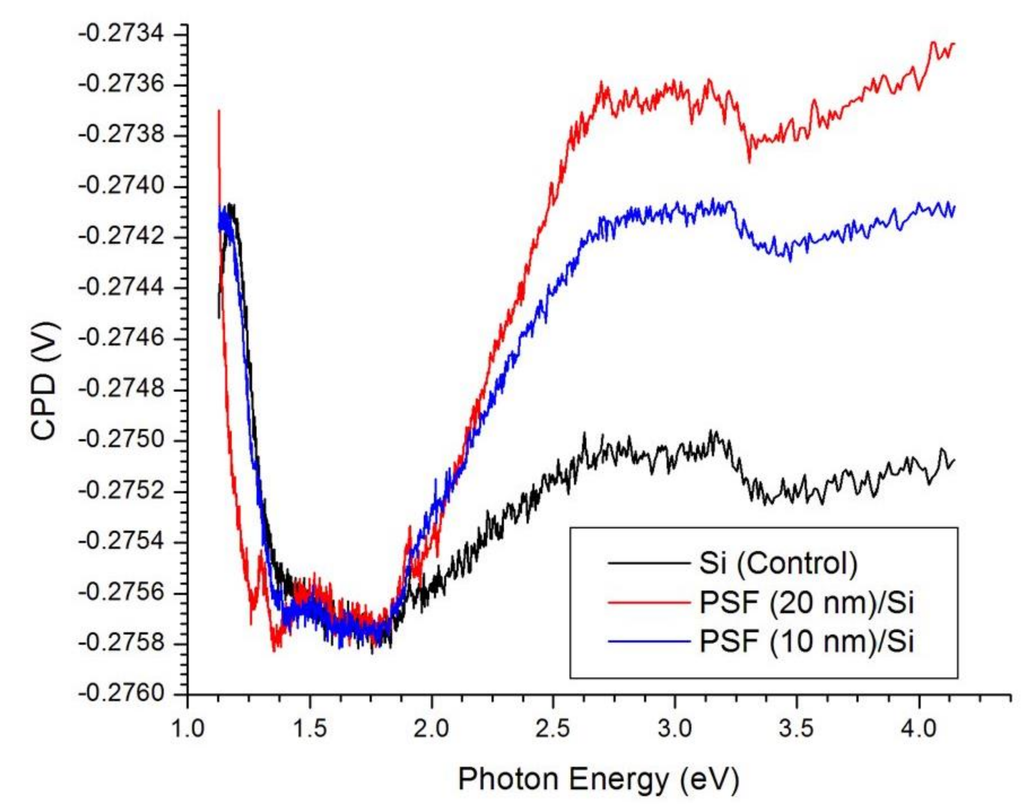
SPV

- SPV allows us to study surface electronic states and surface potential barrier
- Electrons move to and from surface states in response to changes in illumination
- Changes in contact potential difference (CPD) are related to changes in surface potential barrier due to movement of charges

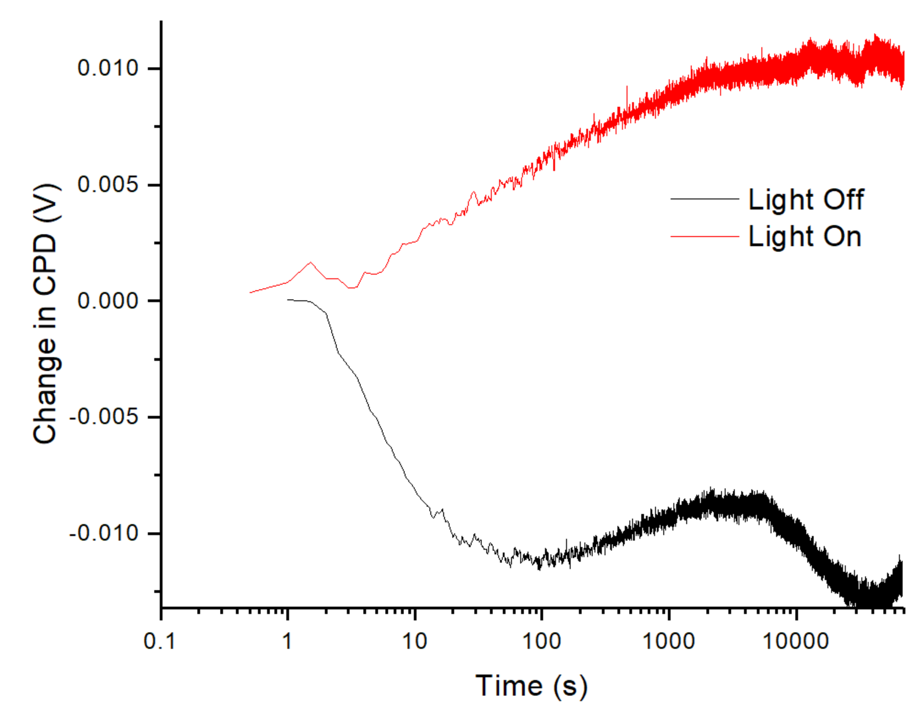


SPV Spectra

Initial SPV studies of polysulfone



SPV Transients

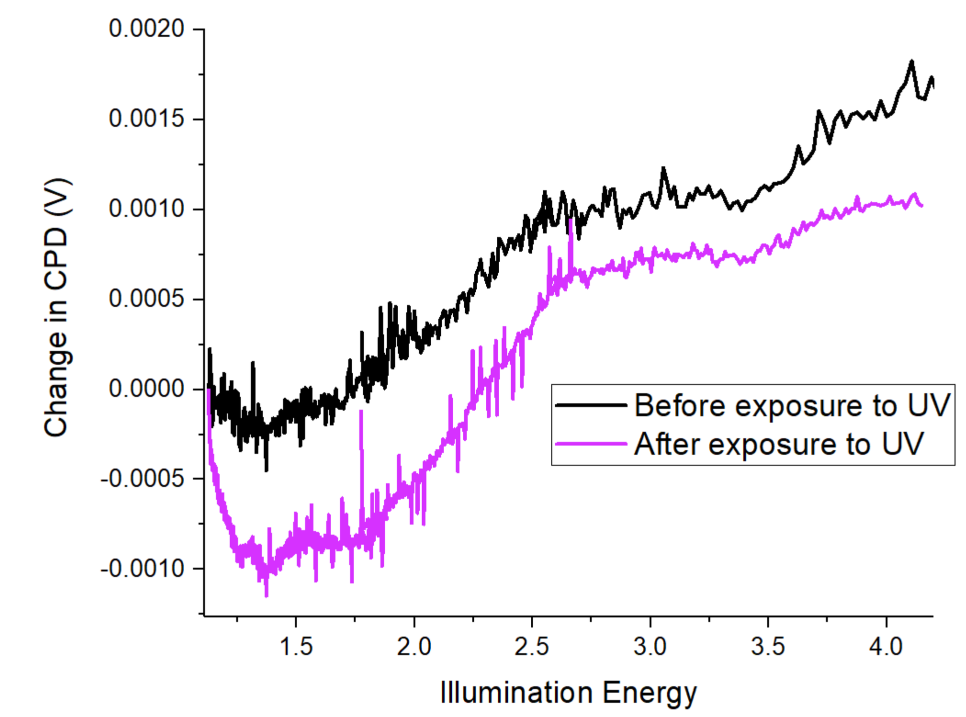


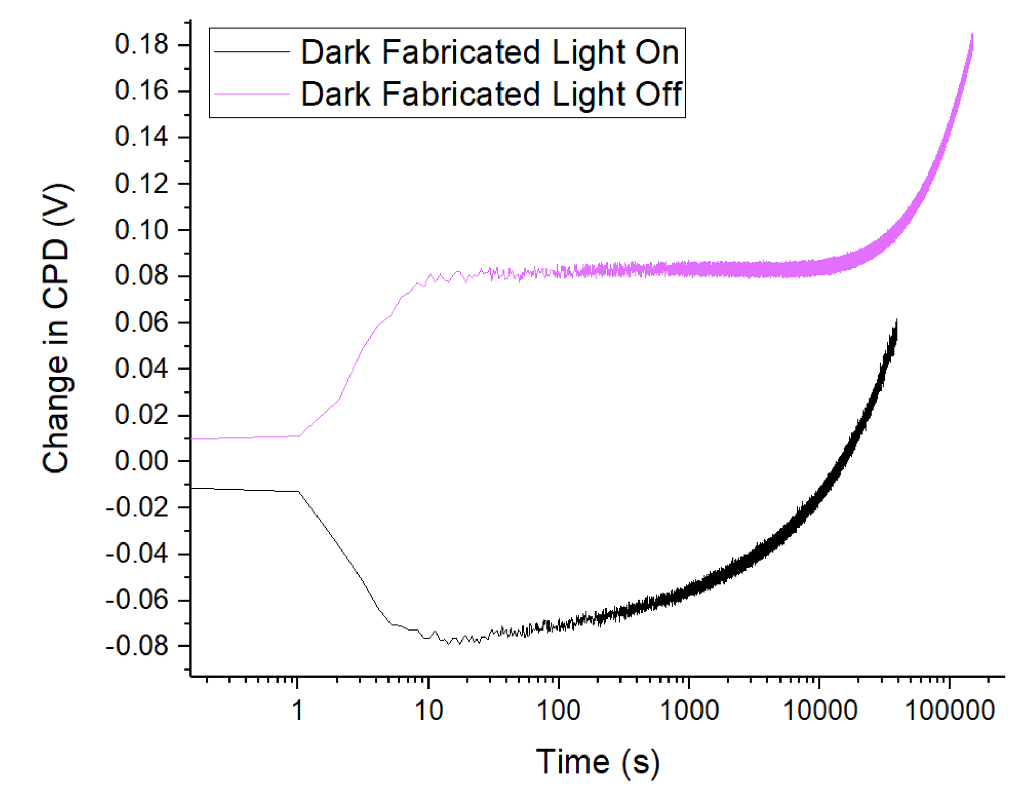
Conclusions

- SPV studies suggest exposure to UV light changes surface electronic properties
- Hydrophilic flipping could be related to energy states at the surface

Dark Fabricated Film

Thin film fabricated in darkness (No UV)





Future Studies

- Continued investigations of surface optoelectronic properties of polysulfone
- Investigations of excitation and emission behavior based on UV irradiation
- Additional contact angle and sliding angle studies to better understand surface energy of polysulfone