Improving the performance of Organic Field-Effect Transistors through Interface Functionalization with Self-Assembled Monolayers

Luiza Batista Capuzzo[1], Marcos da Silva Sousa[1], Paulo Barbeitas Miranda[2]

[1]Instituto de Física de São Carlos, USP, [2]Instituto de Física de São Carlos, USP (*DFCM*)

e-mail: luizacapuzzo@gmail.com

Organic Field-Effect Transistors (OFETs) have attracted significant interest as essential components of flexible organic electronics. They offer several advantages, such as cost-effective processability, flexibility, and stretchability, making them ideal for innovative applications. OFETs are three-terminal devices with the drain and source terminals separated from the gate by a dielectric. When voltage is applied to the gate, charges accumulate at the dielectric/semiconductor interface, so that the drain-source current can be modulated by the gate voltage. The dielectric/semiconductor interface plays a critical role in this process as its chemistry influences the structure of the organic semiconductor at the interface, thereby affecting the mobility of charge carriers. In this study, we will employ Sum Frequency Generation (SFG) vibrational spectroscopy to probe the conformational organization of insulating self-assembled monolayers (SAMs) at the dielectric/semiconductor interface. Additionally, the SAMs will be characterized by their wettability and Atomic Force Microscopy (AFM). The impact of SAMs on OFETs performance will be assessed by observing changes in their electrical characteristics. We will explore the interface effects on bottom-gate, top-contact transistors that use P3HT and Al2O3/SAMs as a semiconductor and dielectric, respectively. These OFETs are an excellent system for our objective because they can operate at low voltage and provide a high on/off ratio [1]. Through this study, we aim to understand how to control the performance of OFETs by modifying the device interfaces.

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