PÔSTER - RESUMO - DISPOSITIVOS ELETRÔNICOS, ELETROQUÍMICOS, SUPERCAPACITORES E BATERIAS

PERFORMANCE OPTIMIZATION OF OFETS BY INTERFACE FUNCTIONALIZATION WITH SELF-ASSEMBLED MONOLAYERS

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Organic Field Effect Transistors (OFETs) are the basis of organic electronics, just as inorganic transistors are fundamental building blocks to current (inorganic-based) electronics. Among their main advantages are low cost, simple fabrication, and versatility, made possible by the chemical design of the organic semiconductor properties. An OFET is a three-terminal device (drain, source, and gate), with the gate isolated from the semiconductor film by a dielectric. The dielectric-semiconductor interface is critical, as its chemistry influences the semiconductor structure, and thus the mobility of charge carriers. The dielectric and/or electrodes are usually functionalized with self-assembled monolayers (SAMs) of surfactants to improve device performance [1]. Previous studies by Miranda et al. [2] showed that, under certain conditions, alkyl chains of SAMs can interact with long-chain molecules inducing mutual conformational order, due to strong van der Waals interchain interactions. Thus, in this work we have investigated whether the interaction between SAM chains and semiconducting polymer sidechains influences poly(3-alkylthiophene)-based devices with chains containing 6, 10, and 16 carbons (P3HT, P3DT, and P3HDT). Electrical measurements indicated that the presence of a loosely

packed dioctadecyl dimethylammonium bromide (DOAB) monolayer resulted in a significant improvement in device performance, with a much more pronounced effect for polymers with longer side chains (approximately 100 times greater mobility for P3HDT compared to P3HT). To further understand the phenomenon, the molecular conformation of the monolayers will be characterized in situ by nonlinear vibrational spectroscopy (SFG) [3]. Thus, we have demonstrated for the first time the use of SAM-polymer side chains interaction to control the performance of OFETs through modifications at the semiconductor-dielectric interface.

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References:

[1] S. Casalini and C. Bortolotti, Chemical Society Reviews v. 46, p. 40–71 (2017)

[2] P. Miranda and V. Pflumio, Journal of the American Chemical Society v. 120, p.

12092–12099 (1998)

[3] A. Lambert and P. Davies, Applied Spectroscopy Reviews v. 40, p. 103–145 (2005)

Palavras-chave: organic transistors; self-assembled monolayers; interface engineering; sum-frequency vibrational spectroscopy.