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Thesis: **"IMPLEMENTATION OF ALTERNATIVE ORGANIC ANODES BASED ON PROCESSABLE GRAPHENE DERIVATIVES AND APPLIED TO SOLAR CELLS"**

Summary:

This work presents the fabrication, characterization, and application of cost-effective, semi-transparent alternative anodes for optoelectronic devices, particularly in photovoltaic applications. Graphene derivatives, SPGSW (solution-processed Graphene suspended in water) and PGD (processable graphene derivative), were synthesized mechanically and suspended in water. These derivatives served as alternative anodes in two setups: (1) a three-layer graphene anode (TLGA) with SPGSW/PH1000/PH1000 and PGD/PH1000/PH1000 configurations, PH1000 is a conductive PEDOT:PSS polymer.

Both SPGSW and PGD films were deposited via drop-casting on a glass substrate and treated with hydriodic acid (HI) and UV-ozone plasma. The transmittance (T) and electrical resistance (R) parameters of these anodes were T (at 550 nm) ~ 78 % and R ~ 88 Ω/sq; and T (at 550 nm) ~ 74 % and R ~ 170 Ω/sq for SPGSW and PGD based electrodes, respectively. (2) The hybrid multilayer graphene anode (HMGA), comprising a PH1000:PGD (4:1 v/v) bulk hetero-junction (BHJ) with 6 layers, was spin-coated onto a glass substrate and treated with HI. HMGA achieved T (at 550 nm) ~ 79 % and R ~ 134 Ω/sq. The chemical, structural, and morphological characteristics of these anodes were analyzed using various techniques: Raman spectroscopy, XRD, optical microscopy, AFM and FESEM. To validate the opto-electronic application, they were implemented, as a concept test, in organic solar cells (OSCs) based on the PM6:Y7 blend. Preliminary results indicated a power conversion efficiency (PCE) ~ 4 % for TLGA based on PGD, ~ 1.4 % for HMGA and ~ 8 % for ITO (control OSCs). These results suggest that graphene derivatives have a promising application as an alternative electrode to ITO in photovoltaic devices, offering an opportunity to improve manufacturing processes. Additionally, it is noteworthy that both, electrodes and OSCs, were manufactured under regular atmosphere conditions; it was achieved through the use of a top electrode implemented in the solar devices based on Field's Metal (FM), a eutectic alloy of Bi, In, and Sn, deposited by drop-casting at low-temperature (T ~ 95 °C), eliminating the need of high vacuum techniques.