PÔSTER - DISPOSITIVOS ELETRÔNICOS E ÓPTICOS (OLED/OFET/OPVS/ETC.)

COMBINING ELECTROLYTE-GATED TRANSISTOR AND SERS FOR ACEPHATE PESTICIDE DETECTION

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Electrolyte-gated transistors (EGTs) and Raman and surface-Raman scattering (SERS) are widely used tools in the field of analyte detection. EGTs are potential candidates as sensors for detecting pesticides, even at low concentrations, due to the phenomena that occur in the electrolyte, which is used as a dielectric layer [1]. SERS is a high-specificity fingerprint spectroscopy technology that can distinguish different molecules by unique molecular vibrational modes [2]. The combining application of SERS and EGT (SERS-EGT) could be an excellent option to improve the sensitivity and reliability of the sensing results. In this context, we present results of the combination of EGTs, based on zinc oxide (ZnO), and SERS to detect the pesticide acephate (ACP). ACP is an organophosphate pesticide used globally in agriculture, classified as moderately toxic (class II). Recent studies show that ACP can easily degrade into different byproducts depending on the process to which it is subjected [3]. One of the byproducts generated from ACP degradation is methamidophos (MAP), a highly toxic pesticide that is prohibited in Brazil since 2012 [4-5]. The easy degradation of ACP into another highly toxic pesticide, combined with the lack of oversight by regulatory agencies, makes it difficult to assess the real extent of the contamination. Our results, using SERS, confirmed the degradation of ACP to MAP. The SERS spectrum of degraded ACP differs from the normal Raman spectrum of the molecule and this may be related to the loss of the carbonyl group in an aqueous medium resulting in MAP. The performance of the EGTs was, initially, evaluated with ultrapure water (WGT), and then we used different concentrations of ACP in water. The preliminary results showed a decrease in the threshold voltage (VTH) as we increased the concentration of the pesticide. We noticed variations in the slopes along the transfer curves of the devices that may be associated with changes in the conduction mechanisms of the semiconductor. These modifications are caused by changes in the electrolyte due to the addition of ACP, and consequently in the electrical double layers (EDLs) that interact with the semiconductor film. The transconductance (gm) is another parameter that showed a considerable change depending on the presence of the pesticide. We observed an increase in gm as the ACP concentration increased. The gm is the most sensitive parameter of the device and is related to the amplification of the electrical signal with a small variation of gate voltage (VGS). Impedance measurements showed an increase in device conductivity as a function of the repeatability of the measurements for the concentration of 1x10-5 mol/L of ACP. The change in conductivity may be related to the presence of dissolved ions in the water due to ACP degradation. Thus, the degradative process of the molecule, confirmed by SERS, significantly influences the response of the device. In summary, the results show a sensitivity of the device to the presence of ACP, indicating that ZnO-based EGT has the potential as an analyte sensor. In summary we show that the combination of SERS-EGTs is a promising tool, which together, can improve the reliability of results in sensor-based transistors.