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A Combined Fiber-Optic Surface Plasmon Resonance and Ta2O5: rGO Nanocomposite Synergistic Scheme for Trace Detection of Insecticide Fenitrothion

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Abstract : The unbridled application of insecticides to enhance agricultural yield has become a matter of grave concern to both the environment and the human health and, thus pose a potential threat to sustainable development. Fenitrothion is an extensively used organophosphate insecticide whose residues are reported to be extremely toxic for birds, humans and aquatic life. A sensitive, swift and accurate detection protocol for fenitrothion is, thus, highly demanded. In this work, we report an SPR based fiber optic sensor for the detection of fenitrothion, where a nanocomposite arrangement of Ta2O5 and reduced graphene oxide (rGO) (Ta_2O_5: rGO) decorated on silver coated unclad core region of an optical fiber forms the sensing channel. A nanocomposite arrangement synergistically integrates the properties of involved components and consequently furnishes a conducive framework for sensing applications. The modification of the dielectric function of the sensing layer on exposure to fenitrothion solutions of diverse concentration forms the sensing mechanism. This modification is reflected in terms of the shift in resonance wavelength. Experimental variables such as the concentration of rGO in the nanocomposite configuration, dip time of silver coated fiber optic probe for deposition of sensing layer and influence of pH on the performance of the sensor have been optimized to extract the best performance of the sensor. SPR studies on the optimized sensing probe reveal the high sensitivity, wide operating range and good reproducibility of the fabricated sensor, which unveil the promising utility of Ta_2O_5: rGO nanocomposite framework for developing an efficient detection methodology for fenitrothion. FOSPR approach in cooperation with nanomaterials projects the present work as a beneficial approach for fenitrothion detection by imparting numerous useful advantages such as sensitivity, selectivity, compactness and cost-effectiveness.

Keywords : surface plasmon resonance, optical fiber, sensor, fenitrothion
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