AN EXPLORATION OF CHEMICAL AGENTS DETECTION USING THE QUANTUM FINGERPRINT^{TM} TECHNOLOGY

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ABSTRACT

The detection of chemical agents using a novel, gas-phase, sensor technology has been examined experimentally in this work. The goal of the work was to determine the feasibility of using solid-state materials as gas-phase Quantum Fingerprint ^{TM}(QF^{TM}) sensors. The energy levels created by various targeted species adhered on the semiconductor substrate surface, acted as charge traps which can be excited and the transient signals associated with their relaxation examined. A Charge-based Deep Level Transient Spectroscopy (Q-DLTS) system has been used to characterize the deep level states created by surface impurities. In this research, critical components have been examined for the development of such sensor technology. These include selection of appropriate semiconductor substrates and metal contacts for ohmic contacts, fabrication protocols and metallic pattern designs for optimal signals, development of sensor technology measurement protocols, and testing of sensor chips under a controlled environment. The substrate materials tested in this work include silicon, silicon carbide, and sapphire. Fabrication of each sensor chip followed stringent material cleaning procedures to prevent contamination that would affect performance and integrity of the metallization. A few chemical agents were selected for testing, which included: water, 1-propanol, isopropanol, methanol, butanol, ethanol, nitrogen gas, argon gas, and methane gas. The testing of the sensor chips was performed in a controlled, high vacuum environment, isolated from the presence of other species. The experimental measurements made in this work have shown some dependency of targeted species concentrations and pressures with electrical charge collected from trap centers.