Novel Silver/Carbon Material for 2, 4-Dinitrotoluene Detection

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ABSTRACT

The prevalent use of nitro-aromatic materials including, 2, 4, 6-trinitrotoluene (TNT) for explosive devices has made their detection crucial in the fight against act of terrorism and detection of military explosives. But rather than attempting to detect TNT, researchers focus on detecting 2, 4-dinitrotoluene (DNT) which is a common impurity in TNT –based explosive. DNT has a higher vapor pressure than TNT, allowing for more sensitivity and easy detection. In the production of munitions and explosives, DNT is used as a gelatinizing and waterproofing agent. High sensitivity and selectivity, combined with the ability to lower the deployment cost of sensors using mass production, is essential in winning the war on explosives-based terrorism.

In this study, the donor based electrode for the detection of DNT was synthesized by modifying the surface of carbon fiber material with zero valent silver (Ag) via chemical deposition. DNT detection was conducted electrochemically in aqueous media of pH 6.0. The cyclic voltammetric oxidation of DNT is diffusion controlled with detection sensitivity increasing with Ag loading of the electrode. The only oxidation product is benzoic acid, which suggests that the difference in performance of Ag-C electrode compared to other available materials is directly ascribable to the electrode fabricated in this study. Detection limit of DNT was 5μM with the electrode showing no signs of degradation after several cycles, and supported by surface behavior of characterized Ag-C electrode. Kinetic study was also investigated. In another study, the fabricated Ag nanoparticle on carbon fiber substrate was used as an efficient surface enhanced Raman spectra (SERS) substrate to detect the adsorbed DNT molecules with a detection limit of 50 ppm. In advent, our developed SERS substrates could have great potential in detecting other nitro-aromatic based-explosive materials, such as TNT molecules.