MOLECULARLY IMPRINTED POLYMER LABELED WITH QUANTUM DOTS FOR DETECTION OF NITROAROMATIC EXPLOSIVES

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ABSTRACT

A sensing device for explosive compounds is a fundamental step towards the capability to detect the presence of landmines, improvised explosive devices (IEDs), and other unexploded ordinance. To detect high explosive compounds such as 2,4,6-trinitrotoluene (TNT), an optical sensor utilizing molecularly imprinted polymer (MIP) technology was developed. This sensor consists of MIP microparticles prepared using methacrylic acid as the functional monomer in a precipitation polymerization reaction. The MIP particles are combined with fluorescent semiconductor nanocrystals, or quantum dots, via a simple crosslinking procedure. The MIP is then capable of rebinding the explosive compound, which quenches the fluorescence of the covalently linked quantum dots.

After preliminary studies of the basic sensing mechanism, a precipitation polymerization reaction was used to create MIP particles with a uniform spherical shape and sub-micron size, as well as MIP particles with a porous mesh-like morphology. A comparison study of these two types of particles indicated that the MIP microspheres were more effective at binding the nitroaromatic explosive TNT and its breakdown product 2,4-dinitrotoluene (DNT). The MIP microsphere-based fluorescence sensing scheme was then entrapped into a sol-gel matrix and applied to a solid substrate sensor platform for detection of vapor-phase explosives. However, the detection method showed poor performance and was unsuitable for sensing of airborne nitroaromatic explosive compounds.