Quantum Dots-based sensors for Explosive Detection

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Detection of nitroaromatic compounds (NACs) is an important issue in many fields, including environmental safety and homeland security. Although accurate detection methods are already available on the market, they require timeconsuming sample preparation and measurement procedures in addition to expensive instruments and trained technical staff. For these reasons they are typically confined in lab environments and in highly sensitive spots such as airports. Recently, colloidal quantum dots (QDs) have demonstrated great potential as luminescent probes for trace explosives detection even if their application is still limited to water or soil samples and requires direct contact with the compounds, whereas vapor detection remains a challenge barely reported in literature. Here we present our recent works for the vapor detection of nitrobenzene, a representative compound, with lead sulphide (PbS) QDs as sensing material. Firstly, we develop a compact, low-cost optical system based on the photoluminescence quenching of solid-state QDs solids casted from the solution phase on a silicon substrate. The system is assembled with low-cost and lowpower components and can be easily operated without the need of specific instrumentation or interaction with a human operator. Furthermore, we demonstrate for the first time that the change in conductivity of an ethylenediamine-capped PbS QDs sensor can be effectively used for explosive detection. Easy fabrication, room temperature detection, low cost, high sensitivity and full recovery after gas release make both the reported devices quite promising for NACs detection applications.