

551g Bionanotechnology-Based Direct Detection of Vx Chemical Warfare Agents

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Chemicals such as sarin, soman, O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate (VX) and O-isobutyl-S-2-diethylaminoethyl methylphosphonothioate (R-VX) are highly toxic nerve agents. Among these lethal chemicals, the VX nerve agents are more toxic and persistent. The V type nerve agents are phosphothiolester neurotoxins. A simple, rapid, and selective monitoring means for OP compounds is urgently needed to monitor the destruction of these chemical warfare agents as required by international treaties. Additionally, terrorist activities and homeland security concerns have further aggravated this need.

Organophosphorus hydrolase (OPH), an organophosphotriester-hydrolyzing enzyme (discovered in soil microorganisms), has been shown to effectively hydrolyze a number of OP compounds, such as parathion and paraoxon, as well as chemical warfare agents, such as sarin and soman. Site-directed mutagenesis has been used to generate OPH mutant with improved catalytic activity for VX nerve agents. This biocatalytic activity of OPH is extremely attractive for sensing of OP compounds that act as substrates for the enzyme rather than inhibitors as in the case of acetyl cholinesterase.

In this paper we report a novel bioassay for the direct determination of VX nerve agents combining OPH mutant with gold nanoparticles. OPH catalyzes the hydrolysis of VX and the Russian R-VX to produce different thiol moieties like 2-(dimethylamino)ethane thiol (DMAET), 2-(diethylamino)ethanethiol (DEAET) and 2 mercaptoethanol, that in turn stimulate the reductive enlargement of gold nanoparticles seeds .in the presence of AuCl₄⁻. The enlargement in the size of the gold nanoparticles results in a blue shift can also be observed in these plasmon bands of gold nanoparticles providing a simple colorometric method for the detection of these compounds.