

Lab-on-a-Chip (LOC) for Detection of Nerve Gas

A hand-held portable device to detect nerve gas as well as insecticides

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Sarin is a colourless, odourless and highly toxic phosphonate that acts as a cholinesterase inhibitor and disrupts neuromuscular transmission. Sarin and related phosphonates are chemical warfare agents, and there is a possibility of their application in a military or terrorist attack. The research

team developed a LOC device for detecting a trace amount of sarin in a small volume of blood sample. The device allows early detection of sarin exposure during medical triage to differentiate those requiring medical treatment from the mass psychogenic illness cases.

The LOC device is based on continuous-flow microfluidics with sequential stages for lysis of whole blood, regeneration of free nerve agent from its complex with blood cholinesterase, protein precipitation, filtration, enzyme-assisted reaction and optical detection. Whole blood is first mixed with a nerve gas regeneration agent, followed by a protein precipitation step. Subsequently, the lysed product is filtered on the chip in two steps to remove particulates and fluoride ions. The filtered blood sample is then tested for trace levels of regenerated sarin using immobilised cholinesterase on the chip. Activity of immobilised cholinesterase is monitored by enzyme-assisted

reaction of a substrate and reaction of the end-product with a chromophore. Resultant changes in chromophore-induced absorbance are recorded on the chip using a Z-shaped optical window. Loss of enzyme activity obtained prior and after passage of the treated blood sample, as shown by a decrease in recorded absorbance values, indicates the presence of either free or regenerated sarin in the blood sample.

The results from the project demonstrate the potential use of a field-deployable hand-held device for point-of-care triage of suspected nerve agent casualties. The device also has other possible commercial applications. For example, it can detect organophosphorus insecticides commonly used in agriculture, offering a low-cost way of monitoring the degree of insecticide contamination in crops and water sources. The device is suitable for tracking the standard of occupational hygiene in agriculture.

