Explosive Detection by Sensor - A Review

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Abstract— There is a need in the society for a fast and reliable detection of explosives because of their use in most terrorist attacks. Chemical sensors, especially fluorescent sensor, seem to fill the need in terms of cost, reliability and handling ability. The localization and detection of improvised explosive devices (IEDs) on the roadside is new issue encountered in the struggle against terrorism. A new method for detection and localization was proposed for IEDs based on magnetic signals. 3-axis fluxgate sensor array system is used for detection of the magnetic field produced around the body by the IED, as most of the IEDs have the ferromagnetic properties .Using this detected sensor data, the detection and localization of the IED can be computed by an appropriate method based on magnetic dipole model and nonlinear optimization algorithm. Sensitive and Selective detection of explosives is very important in countering terrorist attacks. High sensitivity and selectivity, combined with the ability to lower the cost of sensors using mass production, is essential in winning the war on explosives based terrorism. Nano sensors have the potential to satisfy all the requirements for a best platform for the trace detection of explosives.

Key words: Sensor, Fluorescent, Magnetic, Nano Mechanical, Localization, Detection, Explosive

I. INTRODUCTION

In order to avoid terrorist attack, the development of new systems for the detection of explosives has increased since the last decay. Chemical gas sensors are promising for trace detection of explosive vapours because of their sensitivity and selectivity. Explosive detecting drone uses explosive detecting sensor for the detection of 2, 4, 6-trinitrotoluene (TNT) and1, 3, 5-trinitro-1, 3, 5-triazacyclohexane (RDX or hexogen).

A. *Properties of explosives*

They can be classified into six broad classes based on their chemical property

1) Aliphatic nitro compounds, such as nitro methane, hydrazine nitrate;
2) Nitro aromatic compounds, such as TNT, dinitrobenzene (DNB), hexanitrostilbene, picric acid;
3) Nitra mines or nitrosamines, such as octogen (HMX) or RDX;
4) Nitrate esters, such as penetrate (PETN), ethylene glycol dinitrate (EDGN), nitroglycerine, and nitro guanidine (NQ);
5) Acid salts, such as ammonium nitrate; and
6) Organic peroxides, such as triacetone triperoxide (TATP) and hexamethylene triperoxide diamine (HMTD)

B. *The need for explosive trace detectors*

In recent years, explosive-based terrorism has grown extremely because explosive-based weapons are simple, easy to deploy, and can cause hazardous damage. Because of the low vapor pressures of most explosives, frequent introduction of novel explosive compositions, and concealment and weapon delivery schemes hence Detection of explosives is a challenging task. Trace detection of explosives typically involves collecting vapor or particulate samples and analyzing them with a high sensitive sensor system. Currently, many different techniques exist for detecting trace explosives such as fluorescent sensor, magnetic sensor, and Nano mechanical sensor.

II. LITERATURE REVIEW

A. *Improvement of Explosive Detection with a Fluorescent Sensor using a Heating Device*

Damien Rembelskia*, Christele Bartheta, Céline Frénoisa, Geoffrey Gregis, 2014 [1], A fluorescent detector used in this work is presented on Fig.1 (a). A Photo detector is used to measure the intensity of the light emitted by the LED which lights up the fluorescent material. For detection purpose the interaction between the sensitive material and the explosive vapours leads to a fluorescent quenching is used. The particles of TNT and RDX are introduced into the DESORB device at 200°C for a fast generation of the explosive vapours to be detected by the fluorescent sensor.

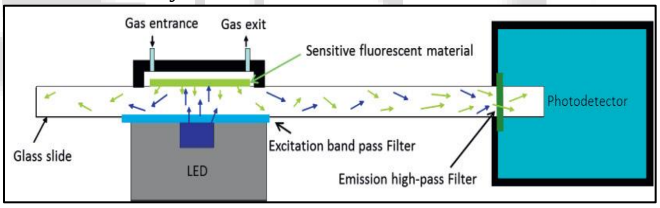

Fig. 1(a): Concept of the fluorescent detector device;

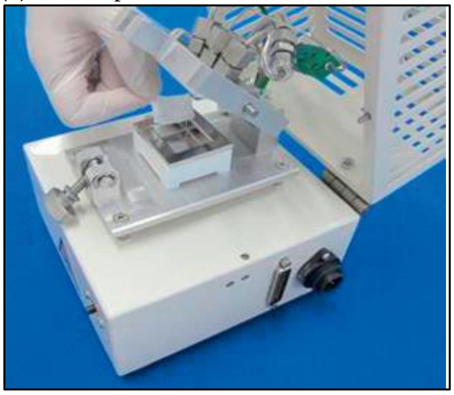

Fig. 1(b): DESORB device

B. *Detection and localization of improvised explosive devices based on 3-axis magnetic sensor array system*

Renhao Liu*, Hua Wang-2010 [2], the localization and detection of improvised explosive devices (IEDs) on the Roadside is new subject encountered in the struggle against terrorist attack. The passive magnetic anomaly sensing system (PMAS), is shown in Fig.2 (a), including a computer, a magnetic sensor array and a patrol car. The IED is placed on the road side, since most of the IEDs have the ferromagnetic properties; the ferromagnetic IED can generate a magnetic field around the road. A magnetic sensor array is supported by a patrol car and detects the magnetic field. Fig.2 (b) shows the 3-axis flux gate sensor array. In this, magnetic sensors are represented in number. Totally there are twenty-one 3- axis flux gate sensors.

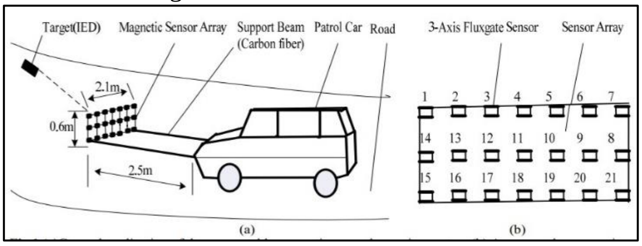

Fig. 2: (a) General application of the car-portable magnetic anomaly sensing system. (b) Are tangularma genetic sensor array of twenty-one3-axis fluxgate sensors.

C. Nano sensors for trace explosive detection

Larry Senesac and Thomasn G. Thundat*-2008 [3] Resistive strain gauges have been used to measure for trace explosive detection Molecular-adsorption-induced Nano mechanical effects are used. Nano mechanical sensors such as cantilever beam shave types are used for experimentation .For example, the resonance frequency varies with mass adsorption of a cantilever beam. The sensitivity of detection depends on the resonance frequency of the cantilever beam. Such a Cantilevers with very high resonance frequencies and Nano cantilevers shows very high sensitivity to mass adsorption phenomenon. If molecular adsorption is restricted to one side of the cantilever, the beam undergoes bending due to adsorption forces. Cantilevers which shows very high sensitivity for bending mode operation has very low spring constants (low resonance frequency).Fig.3 shows the bending mechanism of a Nano mechanical cantilever sensor. The force causing the cantilever beam to bend is independent of the adsorbed mass and depends only on the binding energy of the adsorb ate surface interaction.

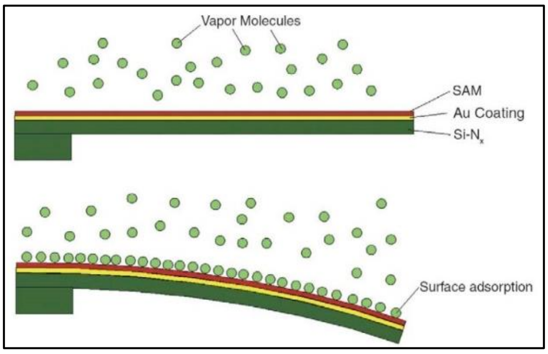

Fig. 3: Diagram showing molecular-adsorption-induced bending of a cantilever arising from differential adsorption. The adsorption decreases the free energy, which changes the surface stress.

III. CONCLUSION

In this study, two sensitive fluorescent materials such as demine and PCS-Py-50% were compared for the detection of TNT and RDX vapours using the heating device DESORB. The purpose of this study is to give a method of localization and magnetic moment estimation of static ferromagnetic IEDs by a PMAS. This work will help the development of magnetic sensor for IED detection. Nano sensors have potential as highly sensitive and very selective signal transduction platforms for an integrated explosive sensor system. Also this study will require a careful control of the pollution of the devices by RDX vapours or particles.

ACKNOWLEDGEMENT

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