New smart sensor could revolutionise crime and terrorism prevention

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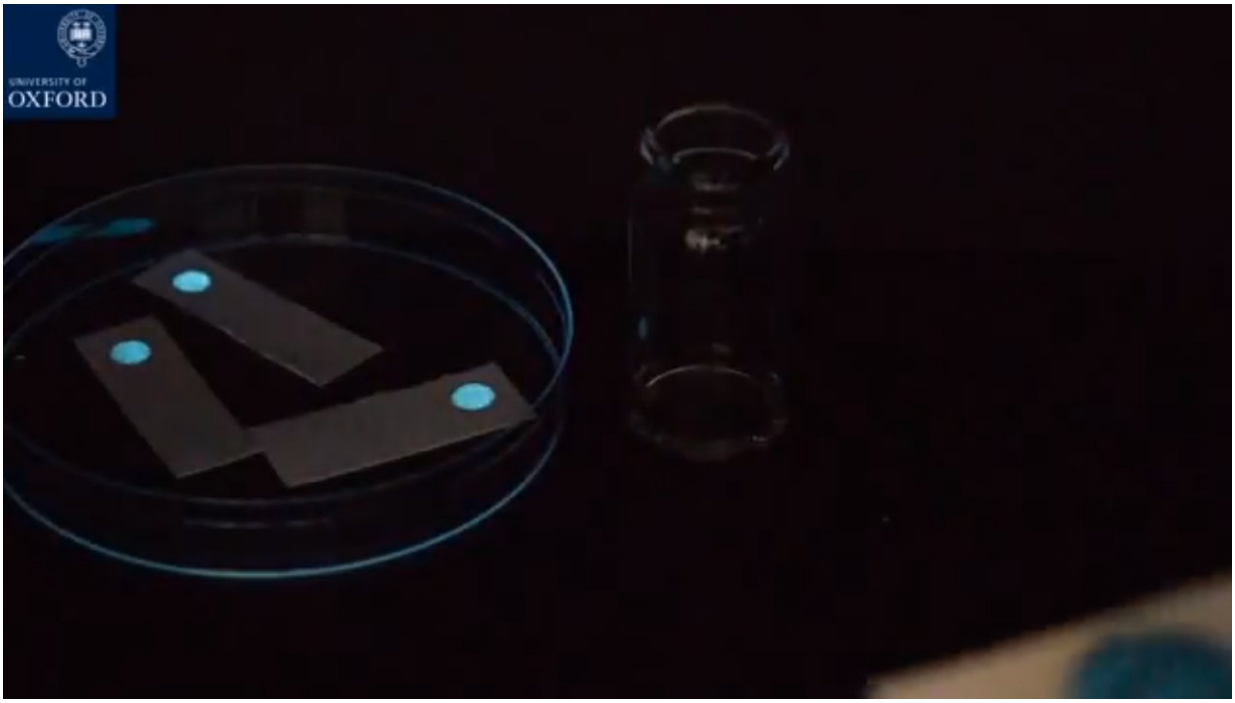

Crime, terrorism prevention, environmental monitoring, reusable electronics, medical diagnostics and food safety, are just a few of the far-reaching areas where a new chemical sensor could revolutionise progress.

Capable of recognising a vast range of reactive surfaces, the technology

can pick-up small quantities of volatile organic compounds (VOCs), such as acetone. When detected the chemical turns the material from blue to green.

Photonic sensors are a fast-emerging and rapidly expanding global market. Oxford's research could be used to develop photonic material compounds known as Metal-Organic Frameworks sensors (MOFs) at low cost. This would enable a variety of new innovative applications, including; hand-held medical devices for non-invasive diagnosis and therapy, biosensors for safeguarding against chemical poisoning and food contamination. Intelligent MOF photonic sensors could also be used to protect society from crime and terrorism. Likely applications range from wearable personal protection devices, to anti-counterfeiting technologies, and reusable optics-based luminescent sensors for protection against harmful environments, such as nitro explosives and toxic gases.

MOFs are highly tuneable and have been described as 'solid molecular sponges', with the ability to soak up and respond to a number of solvents and gasses. They are created from highly porous frameworks where metal atoms are bridged by organic linker molecules. The physical and chemical properties of these frameworks can be engineered to allow scientists to control the precise functionality of the material.

In a study featured in *Advanced Materials*, engineers at the University of Oxford have used material compounds known as Metal-Organic Frameworks (MOFs) to develop a 'photo-chemically' active nano-scale sensing technology. The material senses and responds to light and chemicals, visibly changing colour, depending on the substance that has been detected.

Professor Jin-Chong Tan, who leads the Multifunctional Materials & Composites (MMC) Lab in the Department of Engineering at Oxford

University, said: 'This new material has remarkable physical and chemical properties that will open the door to many unconventional applications. MOF materials are getting smarter, and with further research can be useful for engineering intelligent sensors and multifunctional devices.'

The team has actively taken steps towards translating this technology into societal impact, filing a patent in July 2017, in collaboration with Samsung Electronics Co. Ltd. Over the coming months the researchers will explore healthcare applications for the material, such as deployment of photochemical sensors inside diagnostic hand-held breathalysers for conditions such as diabetes.

Recently, this ground-breaking research has further led to the award of the prestigious European Research Council (ERC) Consolidator Grant of €2.4 million. The funding will support Professor Tan's team with their work developing smart photonic sensors with MOF-based materials technology.

Abhijeet Chaudhari, a doctoral student and the study's co-author, discovered an unconventional synthetic strategy for fabricating porous 2-D nanosheets ((OX-1) of a 3-D MOF material), which could potentially revolutionise the field of photonic sensors.

Professor Tan said: 'Downsizing the typically three-dimensional (3-D) framework architecture of MOFs to yield two-dimensional (2-D) morphologies, akin to topical 2-D nanomaterials like chalcogenides, graphene, and oxide nanosheets, is hard to accomplish. Yet, the development of new 2-D MOF materials is important for engineering advanced applications, for example: photonic sensors and smart switches, thin-film electronics and sensing devices.'

More information: Abhijeet K. Chaudhari et al. Hybrid Materials:

Optochemically Responsive 2D Nanosheets of a 3D Metal-Organic Framework Material (Adv. Mater. 27/2017), *Advanced Materials* (2017).
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