New nanosensors for the detection of TNT

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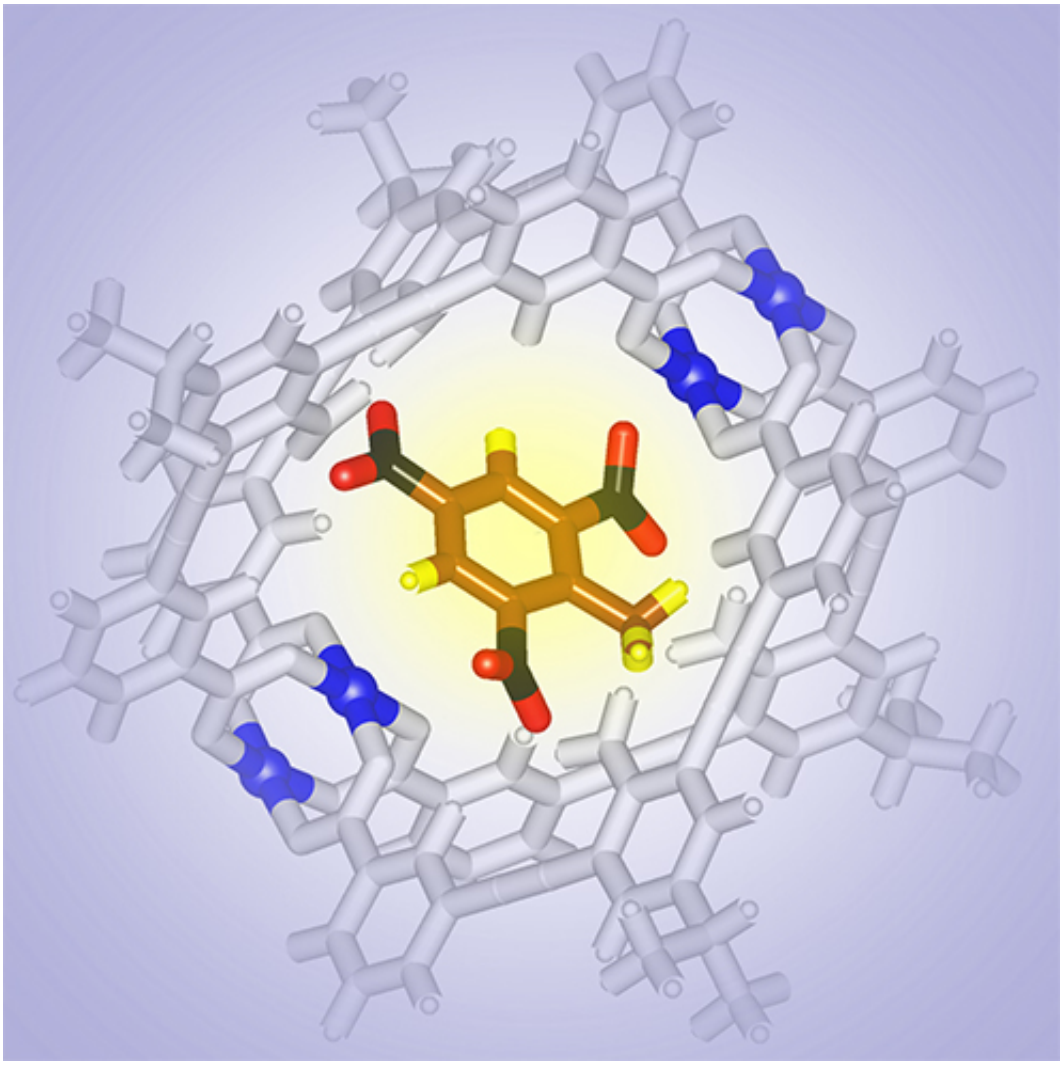

Credit: Delft University of Technology

A new type of sensor has the potential to replace sniffer dogs when it

comes to detecting explosives such as TNT. This week, researchers from a number of institutions including TU Delft are publishing an article about this subject in the American Chemical Society's journal *Nano Letters*.

Cage structures

'For the first time ever, we have used molecules with a lantern-type cage structure to fabricate sensitive nanosensors that can detect explosive substances such as TNT', says researcher Louis de Smet (affiliated with TU Delft and Wageningen University).

'These cage structures have a capacity of about 1 cubic nanometre, which precisely accommodates a single TNT molecule.' Researchers from TU Delft, the University of Twente, Philips Research, the City University of Hong Kong and the University of Melbourne have chemically bound an ultrathin layer of these specially developed cages to the surface of a sensor chip containing a few dozen sensitive nanosensors. A single cage is not sufficient for detection purposes.

Porous

'Porous molecules are used quite often to capture ambient molecules', explains De Smet. 'In the case of relatively small molecules, as with explosives, the challenge is to ensure that the cage structure is not only the right size but that it also has the right anchor points so that the molecule can click into place – thus rendering it detectable. For this work, we therefore use layers consisting of so-called MOP molecules (Metal-Organic Polyhedra). Through variation with a large number of geometric and electronic properties of these complex cage molecules, we are able to capture the 'explosive' molecules we are looking for. And the presence of such a molecule also causes the electrical conductance of the

underlying silicon nanowires to change in a very characteristic way. We can measure this and thus confirm that we have actually found TNT molecules from an explosive.'

Sniffer dog

'Eventually, we may be able to use this type of sensor to detect explosives – in a war situation, for example, or when facing a terrorist threat', says De Smet. 'Currently, very different, qualitative methods are mainly used for this, involving chemical reactions causing colour changes, for instance, or the deployment of sniffer dogs. The great thing about our method is that you can not only detect whether there are traces of TNT but you can also determine the amount.'

More information: Anping Cao et al. Metal–Organic Polyhedra-Coated Si Nanowires for the Sensitive Detection of Trace Explosives, *Nano Letters* (2016). DOI: 10.1021/acs.nanolett.6b02360

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