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Pigment array sensor identifies infectious bacteria

28 April 2011

Researchers led by Illinois University chemistry professor Ken Suslick have demonstrated a quick, simple method to identify infectious bacteria by using an array of printed pigments as a chemical sensor.

Hospitals have used blood cultures as the standard for identifying blood-borne bacterial infections for more than a century. Blood samples are incubated in vials for 24–48 hours, when a carbon dioxide sensor in the vials will signal the presence of bacteria. But after a culture is positive, doctors still need to identify which species and strain of bacteria is in the vial — a process that takes up to another day.

'The major problem with the clinical blood culturing is that it takes too long,' said Suslick. 'In 72 hours they may have diagnosed the problem, but the patient may already have died of sepsis.'

While there has been some interest in using sophisticated spectroscopy or genetic methods for clinical diagnosis, Suslick's group focused on identifying bacteria based on the complex mixture of chemicals that they emit as byproducts of their metabolism. Each species of bacteria produces its own unique blend of gases, and even differing strains of the same species will have an aromatic 'fingerprint'.

The sensor itself comprises an array of 36 cross-reactive pigment dots that change colour when they sense specific chemicals in the air. The colorimetric sensor array is placed in a Petri dish for culturing bacteria together with a blood sample and scanned with an ordinary flatbed photo scanner kept inside a lab incubator. The dots change colour as they react with gases that the bacteria produce.

In only a few hours, the array not only confirms the presence of bacteria, but identifies a specific species and strain, since the pattern of colour change over time is unique to each bacterium.

The researchers showed that they could identify 10 of the most common disease-causing bacteria, including Methicillin-resistant Staphylococcus aureus (MRSA), with 98.8 per cent accuracy. However, Suslick believes that the array could be used to diagnose a much wider variety of infections.

'We don't have an upper limit,' he said. 'We haven't yet found any bacteria that we can't detect and distinguish from other bacteria. We picked out a sampling of human pathogenic bacteria as a starting point.'

Given their broad sensitivity, the chemical-sensing arrays also could enable breath diagnosis for a number of conditions. Medical researchers at other institutions have already performed studies using Suslick's arrays to diagnose sinus infections and to screen for lung cancer.

Device company iSense, which Suslick co-founded, is commercialising the array technology for clinical use.

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