Plasmonic sensor detects viruses（图）

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The first biosensor made from plasmonic nanohole arrays has been unveiled by researchers in the US. The device, which exploits "extraordinary optical transmission", can detect live viruses in a biological solution.

Recent years have seen a number of viral disease outbreaks, raising fears that such viruses could rapidly spread and turn into a pandemic. Controlling future epidemics will require rapid and sensitive diagnostic techniques capable of detecting low concentrations of viruses in biological solutions.

Plasmonics to the rescue

Plasmonics is a new branch of photonics that employs surface plasmon polaritons (SPPs), which arise from the interaction of light with collective oscillations of electrons at a metal's surface.

The new sensor was made by Hatice Altug and colleagues at Boston University and exploits SPP resonances that occur in plasmonic nanohole arrays. These are arrays of tiny holes just 200–350 nm across and spaced 500–800 nm apart on very thin noble metal films, such as those made of gold.

At certain wavelengths, the nanohole arrays can transmit light much more strongly than expected for such a collection of apertures. This phenomenon is called extraordinary optical transmission (EOT) and it occurs thanks to SPP resonances.

Measuring red-shifts

The resonance wavelength of the EOT depends on the dielectric constant of the medium surrounding the plasmon sensor. As pathogens bind to the sensor surface, the refractive index of the medium increases, increasing the wavelength of the plasmonic resonance, explains Altug. This shift can then be measured to identify the presence of virus paricles.

Different viruses can be detected by attaching highly specific antiviral immunoglobulins to the sensor surface. Different immunoglobulins can capture different viruses from a sample solution (see figure).

The researchers have already used their device to detect pseudo viruses that look like highly lethal viruses, such as Ebola and smallpox. "Our platform could be easily adapted for point-of-care diagnostics that can detect a broad range of viral pathogens in resource-limited clinical settings, in defence and homeland security applications as well as in civilian settings such as airports," said team leader Hatice Altug.

Simpler and better

Team member John Connor added that the technique has many advantages over conventional virus detection methods such as polymerase chain reaction (PCR) and cell culturing. Cell culturing is a highly specialized labour-intensive process and PCR, while robust and accurate, cannot detect new or highly divergent strains of viruses – unlike the new sensor.

And that's not all. "The detection platform is also compatible with physiological solutions (such as blood or serum) and is not sensitive to changes in the ionic strengths of these solutions. It can reliably detect viruses at medically relevant concentrations," added team member Ahmet Yanik.

Next on the list for the researchers, who are working with the United States Army Medical Research Institute for Infectious Diseases (USAMRIID), is to make a portable version of their platform using micofluidics.

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