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# Anti-fraud laser and flexible piano unveiled

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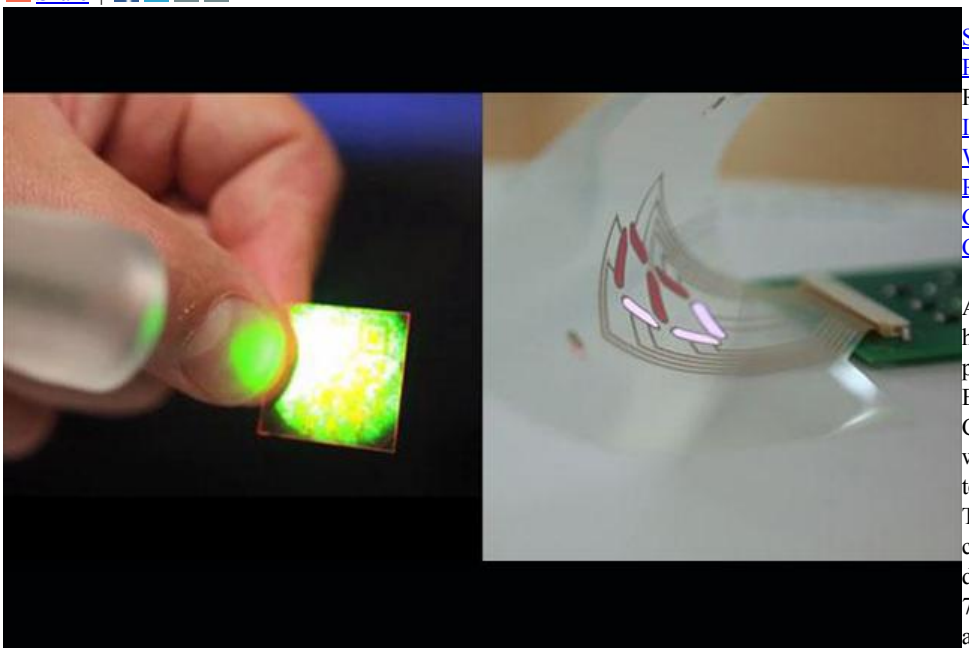
By Edd Gent





(Left) the prototype laser detection device; (right) flexible printed electronics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Anti-fraud lasers and a flexible, transparent piano have been used to demonstrate the potential of new printing technology.

Both innovations are covered in a new report by the Cambridge Innovation and Knowledge Centre, which has been developing advanced manufacturing technologies for photonics and electronics.

The team say the new printed laser "watermark" could be used to stop the illegal trade in counterfeit drugs – according to the United Nations about 700,000 people globally die every year after being administered fake malaria and tuberculosis drugs.

And the new method for printing with a graphene-based ink, which researchers demonstrated by creating a transparent, flexible piano, could be used to make cheap, printed electronics with the one atom-thick material.

Both prototypes were developed within the University's Electrical Engineering Division, and the teams are now working with partners in industry to bring them into commercial use.

Devised by a team led by Dr Damian Gardiner, the anti-fraud detector demonstrates an approach which could be employed to identify fake pharmaceuticals and currency, as well as high-value goods.

"Every year, hundreds of thousands of people are sold fake pharmaceuticals under the mistaken belief that they will help them, while counterfeit products cost companies hundreds of billions of pounds," Dr Gardiner said. "We think that our printed lasers could be used to protect both products and people."

The counterfeit-detection system uses existing methods for printing liquid crystal lasers with inkjet printers, which allow for far more detailed patterns or colour combinations to be specified than would be the case using traditional watermarking techniques.

When a second laser is directed on to the liquid crystal pattern, it emits a light signature that can then be analysed by dedicated software that reproduces that reading as a pattern on a spectrograph, which means each printed laser can be designed to give out its own, unique optical signature making them far more difficult to fake.

Because lasers can be printed on to all sorts of surfaces – such as plastic, paper, metal and glass – the technique could be used to authenticate a wide range of products.

Dr Gardiner said: "Techniques like fluorescence have been used to protect goods for a while, but lasers give us much finer control over brand protection.

"Most importantly, thousands of people are becoming ill or dying around the world every year because they are sold cheap, fake drugs that they believe will help them. We hope this will help guard against that type of malpractice."

The printed piano meanwhile was developed at the Cambridge Graphene Centre, where researchers have developed a graphene-based ink, which has many of the same features of the wonder material such as flexibility, optical transparency, and electrical conductivity, but is much cheaper and environmentally stable than other conductive inks made from precious metals such as silver.

The keys of the transparent piano, designed in collaboration with Novalia Limited, are made from graphene-based inks, which have been printed on to a plastic film, which work as electrodes connected to a simple electronic circuit-board, a battery and speaker.

When a person touches a graphene electrode, the amount of electrical charge held in the key changes, which is then detected and redirected by the circuit to the speaker, creating the musical note.

The same research team, in collaboration with Printed Electronics Limited, has developed a flexible prototype digital display that uses conventional printable materials, but with a transparent, electrically conductive graphene layer on top.

The graphene layer is not only a flexible but also more conductive and transparent than the conventional polymer it replaces meaning these simple displays can be used in a wide range of smart packaging applications such as toys, labelling and board games.

"Both of these devices show how graphene could be printed on to a whole range of surfaces, which makes it ideal for printed electronics," Dr Hasan, the lead

researcher behind the prototypes, said. “For example, it might eventually be possible to print electronics on to clothing and to make wearable patches to monitor people with health conditions, such as a heart problem.”
Another potential application is cheap, printable sensors, which could be used to track luggage around an airport to ensure it is loaded on to the correct plane, or to follow products across a production and supply chain.



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