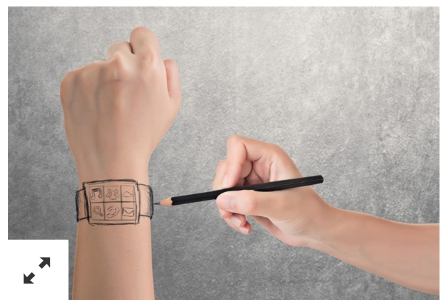
Biowearable could give real-time disease updates

SCIENCE (/SCIENCE) / 11 AUGUST 14 / by LIAT CLARK (/SEARCH/AUTHOR/LIAT+CLARK)



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Biomedical engineers are taking a cue from the technology industry, creating a wearable that will alert diabetics to subtle but important changes in their blood sugar levels. It could be tweaked to help anyone with high blood pressure, lung disease and a variety of other diseases that express specific biomarkers we have already identified.

"Each of these diseases has its own biomarkers that the device would be able to sense," commented Sherman Fan, a professor of biomedical engineering at the University of Michigan. "For diabetes, acetone is a marker, for example."

The wearable being proposed would use a technique called heterodyne mixing to enable a nanoelectronic graphene vapour sensor to detect the different biomarkers from the surface of the skin. It identifies what happens when dipoles (related to molecular charges) for a specific biomarker react with the sensor. Typically a similar system would rely on detecting the charges that occur when molecules bind and change the charge density of the nanoelectric sensor. This was too slow, so heterodyne mixing was introduced.

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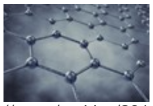
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Samsung commercialises graphene for wearable tech (/news/archive/2014-04/04/samsung-graphene-breakthrough)

The sensor was made using graphene -- a material made from carbon nanotubes famed for being super strong, flexible and conductible, which Samsung has already investigated (http://www.wired.co.uk/news/archive/2014-04/04/samsung-graphene-breakthrough) as a substitute material for its own wearables. Graphene's properties allowed the sensor to pick up molecules that were present at several parts per billion, and ensured the wearable responded in tenths of a second -- according to the Michigan team, without it the process takes hundreds of seconds.

Aside from acetone, the wearable developed in Michigan could also detect abnormal nitric oxide and oxygen levels, which could indicate anaemia, high blood pressure or lung disease. It can pick up the chemical either from a person's breath or, key for a wearable, through their skin.

This type of technology is not new. What is new, is how the Michigan team has managed to shrink it down, speed it up and strap it, potentially, to someone's wrist thanks to the novel approach and the use of graphene.

Speaking about the technique, collaborator Zhaohui Zhong predicted: "With our platform technology, we can measure a variety of chemicals at the same time, or modify the device to target specific chemicals. There are limitless possibilities."

Expanding its uses would mean developing new detection algorithms for different biomarkers, and the team suggests it could be used to detect chemical leaks in the lab or accumulate stats on pollution if members of the public wear them daily.

A paper describing the technique can be read in full in *Nature Communications (http://www.nature.com/ncomms/2014/140707/ncomms5376/ab*

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