Newcastle University spin-out OJ-Bio develops wireless disease detector

BBSRC-funded surface chemistry research at Newcastle University has led to the development of a wireless, hand-held disease detector that is being adapted for a range of healthcare applications by companies around the world.

Newcastle University spin-out Orla Protein Technologies[1] was formed in 2002 when Professor Jeremy Lakey[2] recognised that the technology he had developed through his protein research had a wide variety of possible uses in the life sciences, such as in cell culture and protein drug development.

In 2009, Orla Protein Technologies established OJ-Bio[3] as a joint business venture with Japan Radio Company (JRC), a multinational supplier of electronic communications technology, to develop devices for disease diagnosis using the protein surfaces developed by Lakey. This partnership has allowed them to create a miniature, wireless sensor that can rapidly detect infectious diseases and send the information to a computer using a smart phone.

OJ-Bio's prototype medical diagnostic device. Credit: OJ-Bio

"You take a cotton swab from the back of the throat, put it on this device, and five minutes later you can tell whether somebody's got influenza or not," says Professor Jeremy Lakey from Newcastle University.

Fifteen years of research funding from BBSRC allowed Lakey to develop the protein technology that is central to these devices and refine it to a high enough standard to attract joint investment from a multinational corporation.

A growing area

OJ-Bio's sensors can be used to test for a diverse range of infectious diseases in humans, but potential uses also extend to screening for animal diseases and environmental monitoring. OJ-Bio is now in commercial partnership with companies in the USA, Asia and Europe that are developing the technology for a variety of applications.

Because the devices are small, easy to use, and wireless, they can be adapted for use in doctor's surgeries, pharmacies, and even the home. This type of 'mobile diagnostics' is currently an expanding area worldwide.

Impact Summary

Professor Jeremy Lakey co-founded spin-out company Orla Protein Technologies to commercialise technology developed through his BBSRC-funded research.

BBSRC funding allowed Lakey and his colleagues to refine their technology to a high enough standard to attract joint investment from multinational corporation Japan Radio Company, forming OJ-Bio.

Spin-out company OJ-Bio has developed a miniature, wireless sensor for rapid infectious disease detection and demonstrated its suitability for use in a clinical setting.

OJ-Bio has formed commercial partnerships with leading healthcare companies to develop their sensor for different markets.

The world market for rapid infectious disease testing was estimated at $810M in 2011[4].

"We are at the leading edge of point-of-care wire-

Dr Vicki Lawson, Head of Assay Development, demonstrating the OJ-Bio sensor to directors Dr Roger Duggan and Dr Dale Athey. Credit: OJ-Bio

less-enabled diagnostics, which is a hugely growing area," says Dr Dale Athey, Co-founder and CEO of Orla Protein Technologies, and CEO of OJ-Bio.

30 000 times thinner than paper

OJ-Bio's sensors contain a disposable 'biochip' on which the liquid sample to be tested is placed. This chip detects disease using Lakey's technology, which consists of a layer of antibodies 30 000 times thinner than a sheet of paper.

The antibodies capture proteins from the test sample that are specific to a particular disease and bind them to the surface. An electronic component called a surface acoustic wave filter, commonly found in mobile phones, recognises that there is something attached to the surface, and converts this information into an electrical signal. The signal from the biochip is then sent wirelessly to a computer using a smart phone attached to the device.

"Our technology turns the binding of the flu protein directly into an electrical signal, which is then easily processed by our mobile phone app and either sent to your doctor, or sent to hospital, or just recorded," explains Lakey, "and that enables diagnostics to be carried out in more rural areas or countries where there's less developed healthcare."

Support from BBSRC

Lakey developed these antibody surfaces as a result of his research at Newcastle University in the late 1990s[5], supported by BBSRC responsive mode funding. Recognising that they had a range of possible uses in the life sciences, he co-founded spin-out company Orla Protein Technologies in 2002 with Dale Athey, a clinical biochemist with experience in the diagnostics industry, to commercialise the technology. "Orla was entirely dependent upon BBSRC funding," says Lakey.

A BBSRC Research Development Fellowship awarded to Lakey in 2002 allowed him to study the protein surfaces in more detail so they could be manufactured reliably[6,7]. In 2005, Lakey met Dr Hiromi Yatsuda, General Manager of the surface acoustic wave division at JRC, who suggested combining this protein technology with JRC's surface acoustic wave filters to produce a sensor for disease diagnosis.

"Yatsuda saw the link between what we could do with surfaces and his low-cost, mass-producible electronic sensors, and realised they could be combined into a very sensitive diagnostic tool," says Lakey.

To secure investment from JRC, the researchers needed to measure the antibody layers to a high level of precision so they could reproducibly manufacture surfaces suitable for JRC's sensors. A BBSRC CASE studentship award using the Science & Technology Facilities Coun-

OJ-Bio's prototype medical diagnostic device, showing the disposable biochip on which the test sample is placed. Credit: OJ-Bio

cil's ISIS neutron source, together with Lakey's BBSRC Research Development Fellowship, allowed them to do this[6,7,8].

In 2009, Orla Protein Technologies and JRC formed OJ-Bio to take forward the diagnostic applications of their combined technology. The company has developed a prototype hand-held diagnostic device and formed commercial partnerships with leading players in the healthcare industry to develop this product for different markets. It is currently producing about a thousand biochips each month for use by both OJ-Bio and its commercial partners.

Further funding

The device has attracted funding from several sources to evaluate its potential in diagnostic applications, including testing for flu, HIV and gum disease. A Technology Strategy Board grant allowed the researchers to develop a flu sensor and to demonstrate its suitability for use in a clinical setting. An instrument capable of detecting gum disease is now being developed in collaboration with Newcastle University Dental School with a further £1M of Technology Strategy Board funding.

In collaboration with Dr Rachel McKendry at University College London and the NHS Mortimer Market Centre, a device for HIV testing is under development using funding from the National Institute for Health Research's Invention for Innovation (i4i) scheme. Because the device can be adapted to trap marker proteins from different diseases, it opens up a wide range of potential future applications.

Notes and references

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