Quicker Cardiac Testing Equipment Developed

Scientists at Singapore's Institute of Microelectronics (IME) have developed a rapid and sensitive integrated system to test simultaneously for specific cardiac biomarkers in a finger prick amount of blood. The silicon-based system's features could help physicians arrive at the right diagnosis more quickly in patients suspected of having heart attacks – particularly those who do not show obvious signs of chest pains or shortness of breath, according to researchers at IME, one of the research institutes sponsored by Singapore's A*STAR (Agency for Science, Technology and Research).

The system could cut the time needed for sample preparation and analysis to just 45 minutes from the six hours typically required for the conventional ELISA testing platform (Enzyme-linked Immunosorbent Assay). Because of its multiplexing capability – measuring several cardiac biomarkers simultaneously – the new system contributes to the detail and certainty of diagnosis.

The IME-developed system is a label-free technology that uses semiconducting silicon nanowires (SiNWs) as biosensors. The working principle behind the nanowire biosensors is the field-effect transistor, which is responsible for generating a measurable electrical response when specific antibody-antigen interactions occur on the nanowire surface.

Specific antibodies that are immobilized onto the nanowire surface will elicit antibody-antigen interactions when allowed to come into contact with the variety of charged cardiac biomarkers. Released into the blood when the heart is injured, cardiac protein biomarkers such as troponin-T and creatinine kinases are the basis of medical tests in which a heart attack is suspected.

The system's parallel detection of several biomarkers is made possible by the integration of the following elements into one single microsystem:

- In-built filtration to extract almost instantaneously the test serum from the whole blood sample.
- An array of SiNW chips coated with different antibodies for simultaneous detection of several biomarkers.
- A recording microchip for concurrent and immediate signal-readout from multiple SiNW sensors.

Currently, the first test performed on a patient who is suspected of having a heart attack would be an electrocardiogram, or ECG. However, normal results from an ECG do not rule out the occurrence of a heart attack because the test is not sensitive enough to detect minute anomalies in the reading, particularly when the anomaly needs to be captured within a narrow time window of 2 – 30 minutes

following the onset of a heart attack. When an abnormal ECG reading cannot be established, the patient has to undergo further blood tests to detect the relevant cardiac biomarkers, which is where the time-consuming ELISA procedure comes into play.

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