

Waiting for innovations in periodontal disease diagnosis

Several biomolecules, which can be in the form of proteins or nucleic acids, have been identified as biomarkers, serving as telltale signs for specific diseases. These biomarkers are present in the blood at extremely low levels during the early stages of disease, often making it difficult to achieve early detection directly through whole blood testing.

One prevailing factor that contributes to this difficulty is the general tendency for blood constituents to randomly stick to surfaces with which they come in contact. This is known as fouling or nonspecific adsorption. When the quantity of other biomolecules present in the blood overwhelms the quantity of the biomarkers of interest, fouling can often block the access of these biomarkers to the sensor interface, effectively preventing their detection.

Traditionally, most detection techniques require blood samples to be purified by removing red blood cells and other blood constituents before the biomarkers can be detected or characterized. This purification step is usually time-consuming and laborious, requiring the use of centrifugation and filtration modules accompanied by several washing steps. For this reason, the test needs to be performed in the laboratory by skilled personnel.

In order to realize the detection of biomarkers directly from whole blood, without going through laboratory-based purification steps, it is crucial to ensure that there is minimal, if not zero, fouling on the sensing interface. Apart from simply preblocking the surface with proteins such as serum albumin, one of the ways to re-

duce fouling is through surface modification. Besides surface modification, various lab-on-chip platforms have also been developed for extraction and purification purposes, circumventing the issue of nonspecific adsorption.

While many contributions have been made, especially with regard to biomolecular detection in whole blood, platforms that are much simpler and do not require complicated fabrication procedures are still needed. For instance, a tool for biomolecule detection simultaneous to periodontal pocket probing can be developed, whereby blood droplets during the probing process can simply be introduced to reveal a distinct scale change in the presence of the biomarker. Such platforms require the development of a surface coating capable of performing both whole blood purification as well as biomarker recognition functions effectively.

Innovation requires interdisciplinarity; therefore our work should cross the boundaries of individualized fields. We must focus the technology of several disciplines toward creating a novel system.

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