Integrated electrochemical systems for enzyme-linked immunoassays

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Enzyme-linked immunoassays such as ELISA require labor intensive manipulation (washing steps) to remove unbound enzyme-labeled detection antibodies that would otherwise interfere with the output signal. Restricting the substrate delivery to the immunocomplexes site would greatly simplify those assays. Here we propose an integrated sensing system in a flow-cell for enzyme-linked immunoassays, where a dispersible magnetic probe containing a sandwich-type enzyme-immunocomplex is spatially resolved from the excess detection conjugate in the bulk solution by applying a magnetic field. Once the beads are on the surface of an ion selective membrane (ISM), an electrochemical excitation pulse delivers the enzyme substrate from the back side inner solution to the immunocomplex side (see Figure 1 below) [1]. In the presence of the enzyme-linked immunocomplex on the surface of the ISM, the enzyme substrate ions instrumentally delivered are now partially consumed by the enzyme label. The potential changes with time since the membrane is selective to the substrate activity and proportional to the concentration of enzyme-immunocomplex. This allows for the quantification of the target analyte [2]. This integrated electrochemical immunosensor comprises the immunobinding, enzyme reaction, and electrochemical detection all occurring in the same system, controlled by electrochemistry and magnetic forces.

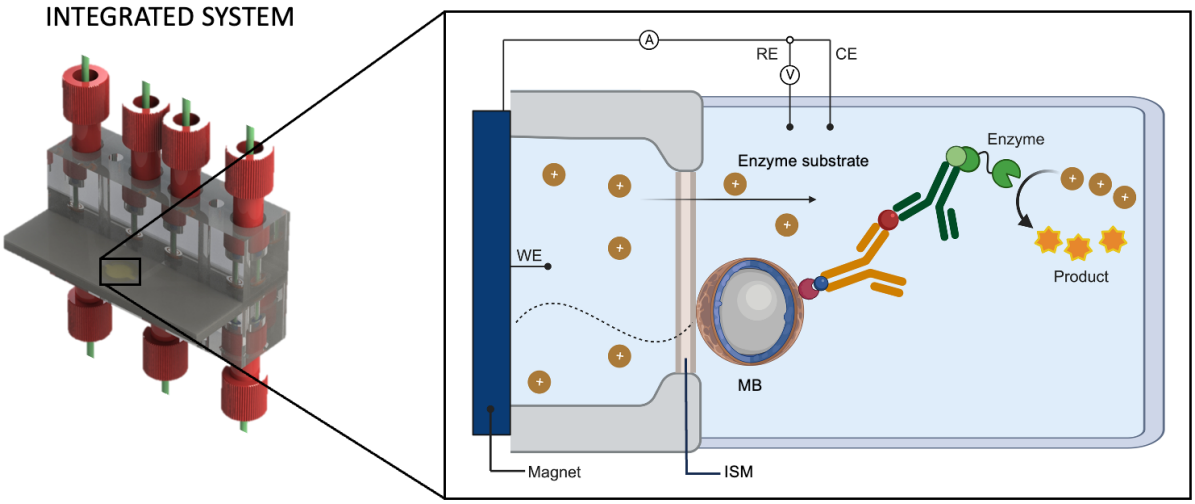

Figure 1. Schematic view of the integrated system and sensing principle. ISM represents the ion-selective membrane. A three-electrode cell contains the working electrode (WE), reference electrode (RE), and the counter electrode (CE).

[1] G. J. Mattos, E. Bakker, *Biosensors & Bioelectronics*, **2023**, *14*, 100351.
[2] J. Ding, X. Wang, W. Qin, *ACS Appl. Mater. Interfaces*, **2013**, *5*, 9488-9493.