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## Graphene protein microfluidic sensors

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Chronic diseases are becoming more prevalent, and the complexities of managing patients continue to escalate since their care must be balanced between the home and the clinical settings. Diabetes is the most advanced example where self-monitoring has been shown to be necessary. Glucometers are point-of-care (POC) devices that have become standard at home and clinical settings. Similarly, many other POC biosensors have also been developed. Enzymes are often used in these sensors because of their specificity and the reaction products can be electrochemically transduced for the measurement. When enzymes are immobilized to an electronically active substrate, the enzymatic reactions can be transduced by direct electron transport. This paper describes an approach for the development of graphene-based POC devices. This includes modifying enzymes for improved performance, developing methods to bind them to the graphene surface, incorporation of the functionalized graphene on a field-effect transistor (FET), and integration into a microfluidic device suitable for home use. This paper describes an approach for the development of a graphene-based POC biosensor platform using glucose as an example of target molecule.

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## Targeting glycocalyx of dying and pathological cells

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Every eukaryotic cell is covered with a complex ensemble of glycans attached to both proteins and lipids of plasma membrane altogether comprising cell glycocalyx. Our recent studies demonstrated that cell death is accompanied with dramatical changes in glycocalyx content. One can target these changes for detection of dying cells & modulating immune response against them; moreover, some pathogens also utilize changes in cell glycocalyx to penetrate host cells and colonize them. Apoptotic cells produce of two types of apoptotic cell-derived membranous vesicles (ACMV) (Bilyy, JBC, 2012), each bearing distinct glycosylation patterns, and they posses distinct role in the immune response and host-pathogen interactions. Formation of 2 types of ACMV are related to two active pathways of modification of glycocalyx in dying cells: a) caspase-dependent activation of plasma membrane-associated neuraminidases leads to the formation of desialylated glycoepitopes on ACMV originating from plasma membrane (PM); b) with the aim to compensate membrane surface loss due to apoptotic blebbing dying cells expose on their surface immature membranes of endoplasmic reticulum (ER), bearing a moiety of oligomannosidic glycans. PM-derived ACMV are usually big (>3μm) and contain nuclear material (histone and DNA), which actively translocates into the ACMV at the late stages of formation. ER-derived ACMV possess oligomannnosidic glycans, attributable to ER, that represent immunologically novel epitopes rapidly cleared by macrophages. Exposure of ACMV-contained nuclear material may support the formation of anti-nuclear (anti-histone and anti-DNA) antibodies in disorders, associated with impaired clearance, like SLE. At the same time adherent-invasive Escherichia coli (AIEC) cells, causing uropthatogenic infections and Crohn's disease, are known to utilize oligomannose-specific lectin FimH at the tip of their fimbriae to adhere to the host cells. Interaction of AIEC with host cells induces formation of ER-derived ACMV by the latter and fosters bacterial attachment to host cells and their colonization.

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