Application Note

# Chemical Sensors Enabled by Carbon Nanomembranes

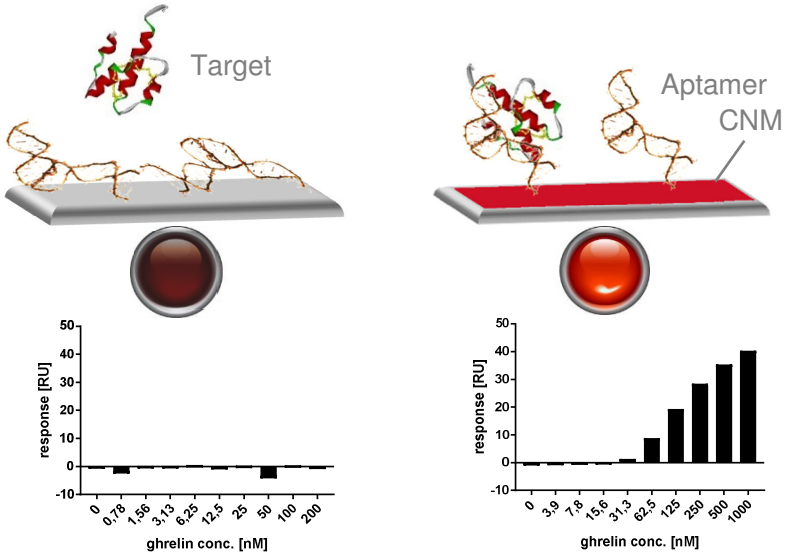


*Fig. 1: Top: Principle of a surface-sensitive sensor with immobilised aptamer "receptors". Bottom: Detection of various concentrations of the peptide ghrelin by surface plasmon resonance by an immobilised ghrelin-binding L-aptamer. Left: Target recognition is inhibited by interactions of the receptors with the surface. Right: Using a CNM nanointerposer, aptamers maintain their three-dimensional structure and thus their target binding properties.*

Oligonucleotides can adopt complex three-dimensional structures comparable to proteins. If specifically selected against a target of interest, they can bind this with high affinity and specificity and can thus be used for diagnostic or therapeutic purposes. These molecules are referred to as "aptamers". Especially L-aptamers (built from mirrored nucleotides), which are not affected by blood plasma, compare favourably with conventional antibodies:

- easy and fast manufacturing
- versatile chemistry
- extreme biological stability
- high physicochemical stability
- high shelf-life
- affinity in nM- to pM-range
- high specificity and selectivity

However, upon immobilisation on surfaces, aptamers often lose their three-dimensional structure due to interactions with the surface. This restriction has hampered a widespread implementation of aptamers in bio-sensors (Fig. 1). As a solution to this problem, **we have developed a nanointerposer based on Carbon Nanomembranes (CNMs) to immobilise nucleic acids and especially aptamers to surfaces.** CNMs are polymer-like, two-dimensional materials with a thickness of one molecular layer (1 nm). They are thin enough to enable the detection of interactions on their surface by underlying sensors. The use of CNMs allows for maintaining the oligonucleotides' three-dimensional structure and thus their target binding properties. Using surface plasmon resonance, we have demonstrated high sensitivity and high specificity for the detection of chemokines (small proteins) in Universal Transport Medium (UTM) used for the collection of nasopharyngeal swab samples (Fig. 2).

Detection systems using this strategy can be label free, e. g. based on refractory index (surface plasmon resonance, ring resonators, ellipsometry), charge (field effect transistors, electrochemical impedance), mass change (quartz crystal microbalance, micro-electromechanical systems), surface stress (cantilever biosensors) or based on optical readout (fluorescence, absorption and luminescence) when used with labelled competitors.

CNM Technologies GmbH and Aptarion biotech AG hold all the rights to this development and can support interested partners in implementing this technology in their sensor concepts in widespread areas, such as healthcare, environmental and food analysis as well as civil security.

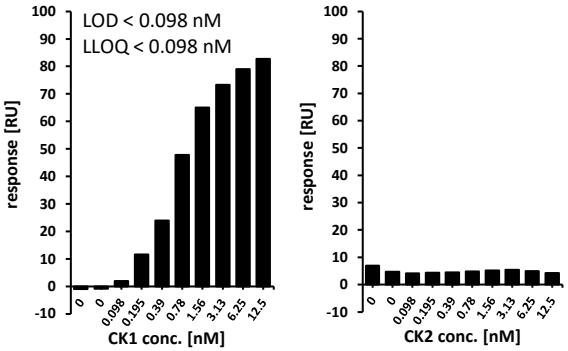


*Fig. 2: Specific detection of various concentrations of chemokine 1 (CK1) in UTM by an anti-CK1 L-aptamer immobilised to a CNM on a surface plasmon resonance chip. No binding of chemokine 2 (CK2) to the anti-CK1 L-aptamer. LOD: Limit of detection, LLOQ: Lower limit of quantification.*

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