Gold nanoparticles SPRi enhanced signal for small molecules detection with split aptamers

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Aptamers are single-stranded DNA or RNA molecules capable of binding to target molecules like proteins, metal ions or drugs. Due to their specific binding affinities and other advantages compared to antibodies (higher stability, lower cost, easy chemical modification...), they provide a great opportunity to produce sensing surfaces for effective and selective detection of small molecules.

Surface Plasmon Resonance imaging (SPRi) has become one of the most widely used label-free method for the study of bio-recognition events on surfaces. This technique provides a rapid approach, however, limited in sensitivity by low refractive index changes occurring when small molecules (<500 Da) are captured on the biosensor. Whereas significant reflectivity variation are observed upon the interaction of large molecules like proteins to the sensing interface, for small targets such as adenosine, the reflectivity variation is often too small to be detected by SPRi. Thereby, only few studies have been reported SPRi-based biosensor for small molecules detection using aptamers.

We developed a bioassay based on three different but compatible and complementary strategies [1, 2]: 1/ the engineering of split aptamer sequences adapted from the adenosine model aptamer, 2/ the use of gold nanoparticles for Surface Plasmon Resonance amplification signal and 3/ the thermodynamic stability of the complex formed to quantify the small molecule adenosine.

The experimental results have demonstrated that the combined strategies allow us to obtain state-of-the-art detection limit below 50nM. Furthermore, the determination of the melting temperatures of the complex formed by the split aptamers and the adenosine targets open the door for an access to the thermodynamical parameters.

[1] F Melaine, Y Roupioz, A Buhot, **Microarrays 4**, 41-52 (2015).
[2] F Melaine, C Coilhac, Y Roupioz, A Buhot, **Nanoscale 8**, 16947-16954 (2016).

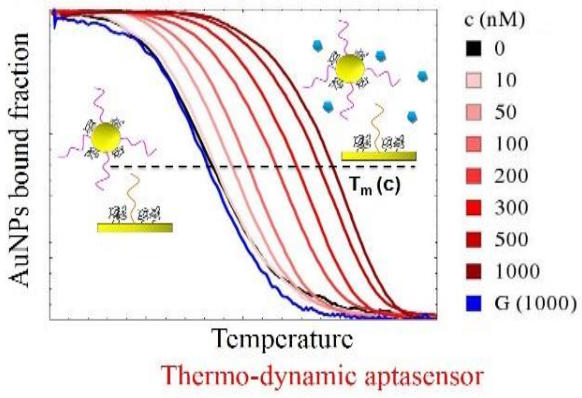

Figure 1: Adenosine detection from melting temperature shift of split-aptamer functionalized AuNP.