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Fluorescence Enhancement of Labeled Oligonucleotides Using Plasmonic Gold Nanorods Toward Biosensing Applications

Biosensor devices have potential application in clinical diagnosis, because some diseases may be detected from the presence of biomarkers in urine, body tissues or blood [1]. One strategy for the development of these devices is to use colloidal metal nanostructures, mostly because they strongly absorb and scatter light at characteristic wavelengths due to the localized surface plasmon resonance (LSPR) [2]. Furthermore, these plasmonic sensors can be used as optical nanoantennas to couple light more efficiently in excitation and emission from fluorescent dyes [3]. In addition, the response of the sensor is concentrated at regions of large plasmon-enhanced near field, or hot-spots, which in gold nanorods are located at their tips (Fig. 1). These hot-spots can be exploited in plasmonic sensors to probe molecular binding events. In this sense, the site-selective functionalization of plasmon hot-spots with bioreceptors is fundamental to create plasmonic sensors with improved response by capturing the target species at the most sensitive regions of the nanoparticle [4]. Here, we report the enhancement of fluorescence of oligonucleotides labeled with ATTO647N dye (Fig. 2) by using gold nanorods as plasmonic antennas. We observe strong fluorescence bursts that are attributed to the dye-labeled oligonucleotide exploring the hot-spot regions at the tip of the gold nanorods.

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References

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Figures

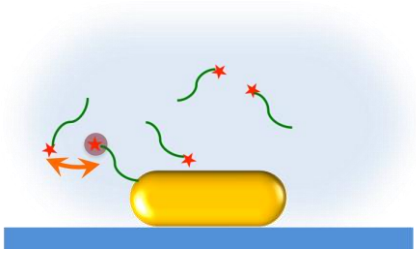

Figure 1: Scheme showing the fluorescence enhancement experiment that depicts oligonucleotides (green line) labeled with Atto-647N dye (red star) in solution diffusing around a gold nanorod and eventually exploring the hot-spot regions (tips).

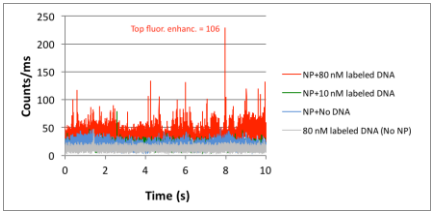

Figure 2: Emission intensity time trace measured from an individual gold nanoparticle: in the absence of Atto-647N dye labeled oligonucleotides in solution (blue curve); in the presence of oligonucleotide labeled with Atto-647N dye in solution: 10 nM (green curve) and 80 nM (red curve); emission time trace from a region of the surface without any particle, but in the presence of 80 nM oligonucleotide labeled with Atto-647N dye (grey curve).