Silver island paths as printed plasmonic biosensor

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Well-defined paths assembled of silver islands were fabricated by combining photolithography with wet-chemical synthesis. The width of the paths was 20 microns with potential to make them thinner. The islands feature lateral sizes of the order of 100 nm, and similar heights, thus promoting localized plasmon resonance [1,2]. The plasmon resonance is an efficient way to improve the optical contrast, as its interaction with emitters can lead to strong enhancement (or quenching) of emission.

The substrates were tested using photoactive protein, in this case peridinin-chlorophyll-protein (PCP) photosynthetic complex from algae [3]. Solution of PCP was deposited on silver island paths (SIPs) in a polyvinyl alcohol polymer layer via spin-coating. Wavelength-dependent fluorescence imaging as well as time-resolved fluorescence of the photoactive proteins were carried out using wide-field fluorescence microscopy and confocal microscopy, respectively.

An exemplary result is shown in Fig. 1, where a transmission image is compared with the fluorescence image obtained for the same area. The excitation wavelength used for acquiring the map was 535 nm, which is close to the expected maximum of the plasmon resonance of the SIP structure [2]. The SIP structure is clearly visible in both images, indicating – for the fluorescence image – that the coupling between the photoactive PCP protein and plasmonically active SIP is rather strong. Indeed, the intensity enhancement is over threefold, with this value being an underestimation. As evidenced by decay time shortening, the radiative rate enhancement is approximately 10-fold in this structure.

Summarizing, the coupling between printed SIP structures and PCP complexes leads to a strong contrast in the optical response, which enables direct imaging of photoactive protein emission. This result shows that SIP can potentially be a plasmonic sensing platform. Initial results obtained for SIP substrates functionalized for specific conjugation reinforce this conclusion, so do the observations of single protein fluorescence enabled with these cheap and efficient substrates.

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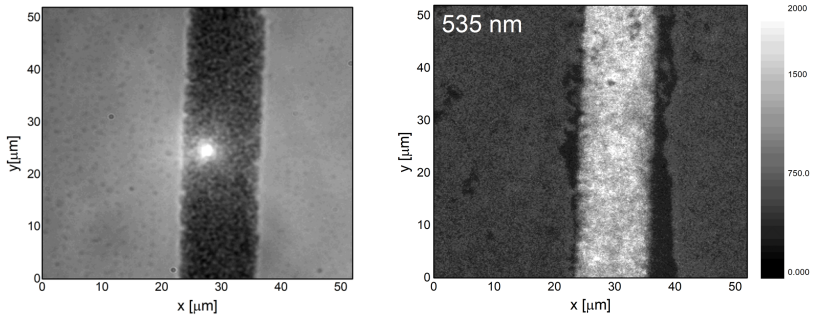

Fig. 1 (A) Transmission image of SIP (B) fluorescence map of PCP emission at the same place measured for 535 nm excitation.

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[3] S. Mackowski et al., J. Fluoresc., 18, (2008), 625–631.