

ENHANCEMENT OF SINGLE MOLECULE FLUORESCENCE DETECTION IN SUBWAVELENGTH APERTURES

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KEY WORDS: subwavelength aperture, fluorescence correlation spectroscopy, fluorescence detection enhancement.

Fluorescence Correlation Spectroscopy is used to investigate fluorescent molecules in solution diffusing in subwavelength apertures milled in Aluminium films (with diameter ranging from 110 nm to 420 nm). We observe a reduction (up to 400 fold) of the observation volume as compared to the open solution conventional confocal volume. This reduction comes together with a significant increase of the fluorescence count rate per molecule (up to 8 fold) and a reduction of the molecular lifetime.

The observed fluorescence enhancement, associated to the measured lifetime reduction, demonstrates that the molecular energy levels branching ratio are affected for dye molecules diffusing in nanostructures as compared to open solution. Although non radiative processes due to the metal surface are most probably involved in the observed lifetime reduction, the fluorescence enhancement demonstrates that the overall effect is in favour of the radiative processes as compared to open solution.

Moreover, our results appear to be consistent with numerical electromagnetic computations of the excitation power density into the aperture volume. By taking benefit of this significant enhancement such apertures could serve as efficient nano-optical sources or nano-wells for fast and highly parallel molecular analysis at high concentration.

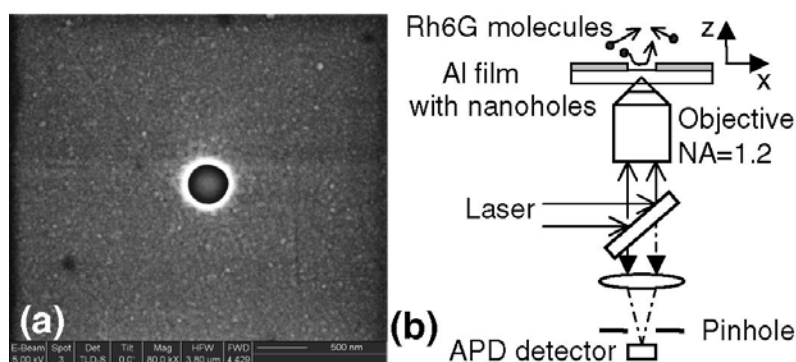


Figure 1: (a) scanning electron microscope image of an isolated subwavelength aperture milled in an Al film coated on a microscope slip. (b) Schematic view of the optical setup (APD : avalanche photodiode).