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PhD Dissertation Announcement

FLUORESCENCE AND LONG RANGE SURFACE PLASMON RESONANCE STUDY FOR BIOSENSING APPLICATIONS

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A compact fluorometer for biosensing application is constructed. The distinguished feature of the setup is the use of an ellipsoidal reflector as an optical collector of fluorescence light. A traditional collection lens with numerical aperture of 0.5 can only collect a few percent of the available signal, while the incorporation of the ellipsoidal reflector enables the increase of collection rate at least 5 times, so that nano molar level concentration is detectable. A linear relationship between the concentration of fluorescent dye and the fluorescence intensity is achieved with correlation coefficient R = 0.99979. The 3-σ detection limit is 5nM for samples in micro liter volume. Meanwhile, it is found that laser light scattering by dirts and scratches on the sample cell windows and by turbidity in the sample solutions is the dominant limitation to increase the detection sensitivity. Approach to solve this problem is suggested.

Surface Plasmon Resonance (SPR) technology enjoys an increasing interest in biosensing applications, due to its high sensitivity and label free measurement. In this work, experimental studies on the effect of intermediate dielectric films on the resonance behaviors of the multilayer SPR biosensing configuration were performed. In this investigation, ten simple and complex oxides and fluoride including MgF_2 and MgO, SiO_2, TiO_2 and complex PZT family dielectric materials were investigated. The materials covered a wide range of refractive index from 1.19 of the porous silica film to 2.83 of the TiO_2 film. The resonant curves of the multilayer SPR configurations were taken from an angular modulated Kretschmann setup under fixed incident wavelength. The intermediate dielectric layer has no strong effect on the SPR resonant angle and minimum reflectance at resonant point, while apparent reduction of the width of the resonant curves was observed with intermediate dielectric films such as MgF_2, TiO_2 and PLZT. Physics understanding of the results are discussed. Better performance of the multilayer SPR biosensor incorporating these dielectric films is expected.

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