Graphene – MIET: Optically Measuring Distances with Ångström Resolution

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Single-molecule fluorescence imaging has become an indispensable tool for almost all fields of research, from fundamental physics to the life sciences. Among its most important applications is single-molecule localization super-resolution microscopy (SMLM) (PALM [1] , STORM [2] , fPALM [3] , dSTORM [4] , PAINT [5]) which uses the fact that the center position of a single molecule's image can be determined with much higher accuracy than the size of that image itself. However , a big challenge of SMLM is to achieve super-resolution also along the third dimension. Recently, Metal-Induced Energy Transfer or MIET [6 , 7] was introduced as a technique to axially localize fluorescent emitters [8 , 9]. It exploits the energy transfer from an excited fluorophore to plasmons in a thin metal film. Here , we show that using graphene as the "metal" layer , one can increase the localization accuracy of MIET by nearly tenfold , and we demonstrate this by axially localizing single emitters and by measuring lipid bilayer thickness values with Ångström accuracy.

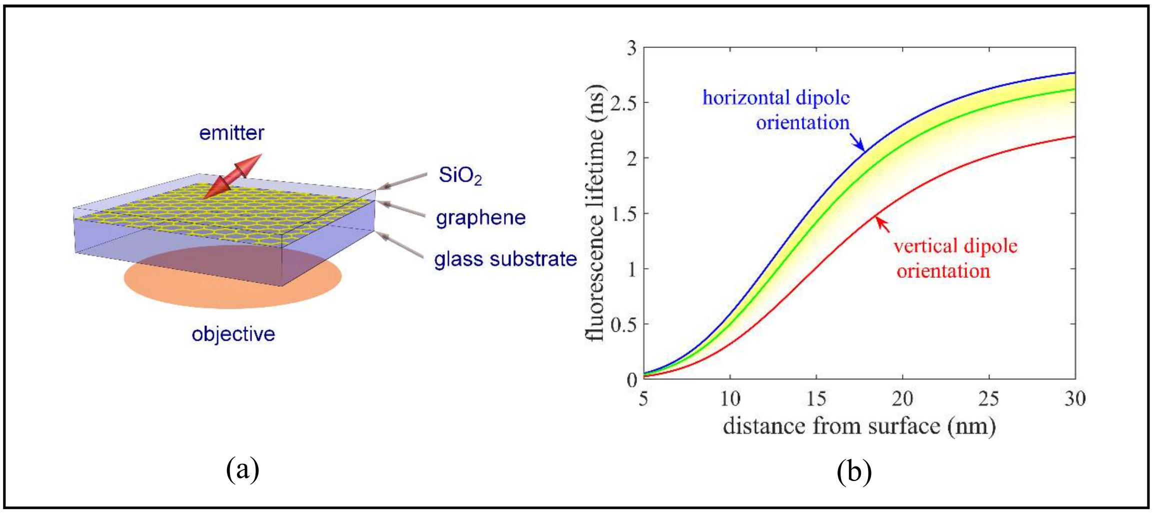

Figure 1: **(a)** shows schematic of a graphene-MIET experiment **(b)** Calculated graphene-MIET calibration curves for Atto-655 molecules near graphene : Blue and red curves show the calibration curves which one would have for purely horizontally or vertically oriented molecules. The yellow density plot shows a distribution of graphene-MIET curves where the shading reflects the weight proportional to the orientation distribution obtained separately from defocused imaging measurements.

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