Graphene modulated Surface Plasmon Resonance

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1. Introduction

Graphene and 2D materials have gathered great attention lately, due to its property of interface modification. Combining graphene with metals, it would be able to modulate the carrier concentration of metals and also plasmon frequency.

In this abstract, the variation of V_g and plasma frequency (ω_p) have been demonstrated successfully on gold films with graphene and without graphene. Forward scattering spectra of the slit-groove structures exists Fabry-Perot interference. This work could extend to the graphene modulated nanophotonics devices [1]. For example, the SPPs propagate on the graphene-metal surface can be utilized to develop graphene-plasmonic waveguide [2].

2. Results and discussion

Slit-groove was fabricated by using Focus-ion-beam on 200 nm Au thin film. Then utilized the wet-transfer technique to transfer CVD-grown graphene onto Au slit-groove. Figure 1(a) shows the schematic of slit-groove. Figure 2(a) shows the measured scattering spectra of Au slit-groove with and without the graphene layer. The oscillations from the measured scattering spectra are due to the interference of SPP and transmitted light. The V_g of SPPs could be defined as [3]

$$v_{gr} = 2p(\frac{\Delta w}{2\pi}) \ , \tag{1}$$

Δw is the period of oscillations, p is the distance between the slit and groove. By equation (1), we obtain the results in Figure 2(b).
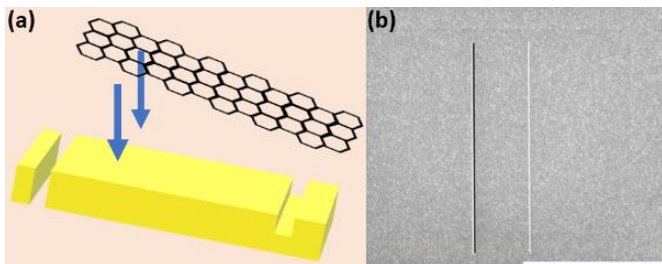

Figure 1. (a)Schematic of Au slit-groove and transferred graphene. The distance between slit and groove is 4 um. (b) Scanning electron microscope image of Au slit-groove and the scale bar is 10 μm.

By observing the nearfield distribution of slit-groove in Figure 3, the SPPs could be excited by the transmitted light from slit and propagate on the surface of gold film.

3. Conclusions

In summary, as the results of Figure 2, which is a good evidence of graphene modulated surface plasmon resonance

that can be widely use in graphene-plasmonic hybrid structures. Furthermore, slit-groove type structures are good candidates to observe the group velocity of SPPs with novel 2D materials.
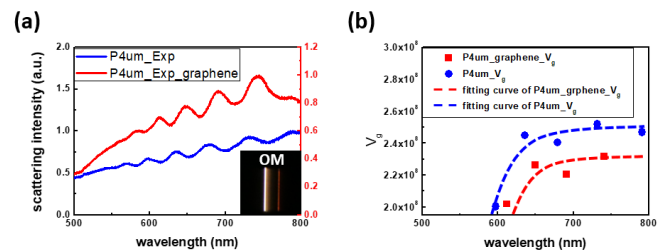

Figure 2. (a)Measured scattering spectra and the inset is the optical microscopy image of Au slit-groove. (b) V_g of Au slit-groove.
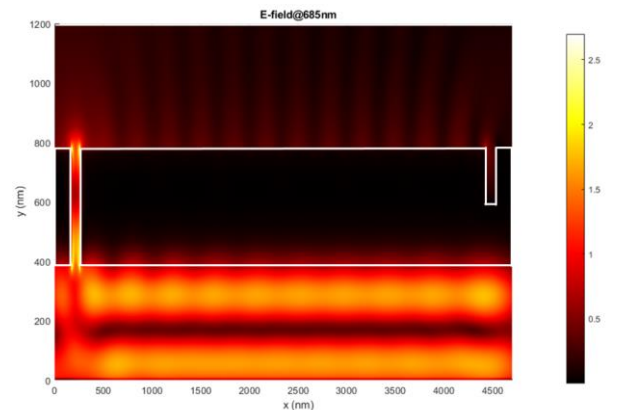

Figure 3. Simulated electric field distribution of Au slit-groove at 685 nm

References

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