Magneto Plasmon Excitation on Chemical Compounds

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Abstract : The frequency range that surface Plasmon polariton (SPP) mode exists is mainly existed on chemical material., The SPP mode at high frequency has extremely large loss or can be cutoff, which limits the potential applications of SPP in the field of optical interconnectionwith high permittivity dielectrics above metal surface, active SPP devices and so on. The surface mode guided by metal/dielectric multilayers meta-material has been studied based on the theory of electromagnetic fieldto extend the frequency range of SPP mode, It is demonstrated that surface mode not only could be supported by the meta-material but also extends the frequency to where conventional metal SPP. Meanwhile, the characteristics of this surface mode, such as dispersion relation, frequency range, propagation loss and skin depth in metamaterial and dielectrics, are also studied in presence of magnetic field. It is shows that, by varying the structure parameters, the meta-material guided SPP mode presents its advantages and flexibility over traditional metal one. The author studied the magneto Plasmon excitation on chemical compounds like RbI, NaBr, LiF and carbon tubes in this field which is great advantages in the magnetic field of surface Plasmonchemical materials.

***IndexTerms* - Surface Plasmon, Magneto Plasmon, Tensor Analysis, Theoretical study.**

I. INTRODUCTION

Collective electronic excitations in metallic systems influence many physical and chemical phenomena, such as catalytic processes, epitaxy, charge transfers at interfaces, and dynamical processes [1–4] and, hence, they have been widely studied in recent years [5–11]. In particular, investigations on noble-metal surfaces are motivated by fundamental interest in understanding the electronic response of such systems. As a matter of fact, the Jellium model, usually applied for describing screening properties in simple metals, is not realistic in this case as a consequence of the presence of localized d electrons [12]. Accordingly, several attempts have been undertaken in order to include band-structure effects in theoretical models [3, 13,]. For Ag, the s–d polarization model correctly reproduces the main experimental findings. The excitation of surface Plasmon (SP) has been investigated using many spectroscopic techniques such as electron energy loss spectroscopy (EELS) , optical absorption and transmission , photoemission and inverse photoemission , surface-enhanced Raman spectroscopy , scanning tunneling spectroscopy (STS) , and energy-filtered low-energy electron microscopy[14] .This study is taken by several scientist theoretically by using Tenser analysis methods of dielectric constant in presence of surface substances

The author investigated surface properties of chemical substances by using spatial dispersion relation between Plasmon frequency and propagation constants. The effective charge is a measure of iconicity of polar semiconductors. Thus width of the band increases with increase in iconicity of atoms.

Frequency of Surface Plasmon on chemical compounds in magnetic fields

We know that the dielectric functions$\varepsilon(\omega)$ is no longer a scalar In the presence of the magnetic field. It is now a tensor ε_{ij} with non-zero off diagonal elements and is given by:

$$\varepsilon_{ij} = \varepsilon_L \delta_{ij} - \frac{\omega_p^2}{\omega^2\left(\omega^2 - \omega_c^2\right)} \; [\omega^2 \delta_{ij} - \omega_{ci}\omega_{cj} \underline{+} i\delta_{ijk}\omega\omega_{ck}] \quad - \quad (1)$$

To study the surface Plasmon optical phonon mode in the presence of magnetic field in the non-retarded limit the graph is plotted between ω_c/ω_t and ω/ω_t. The equation is used as:

$$\varepsilon_0 + \varepsilon_L - \frac{{\omega_p}^2}{\omega(\omega - \omega_c)} = 0$$

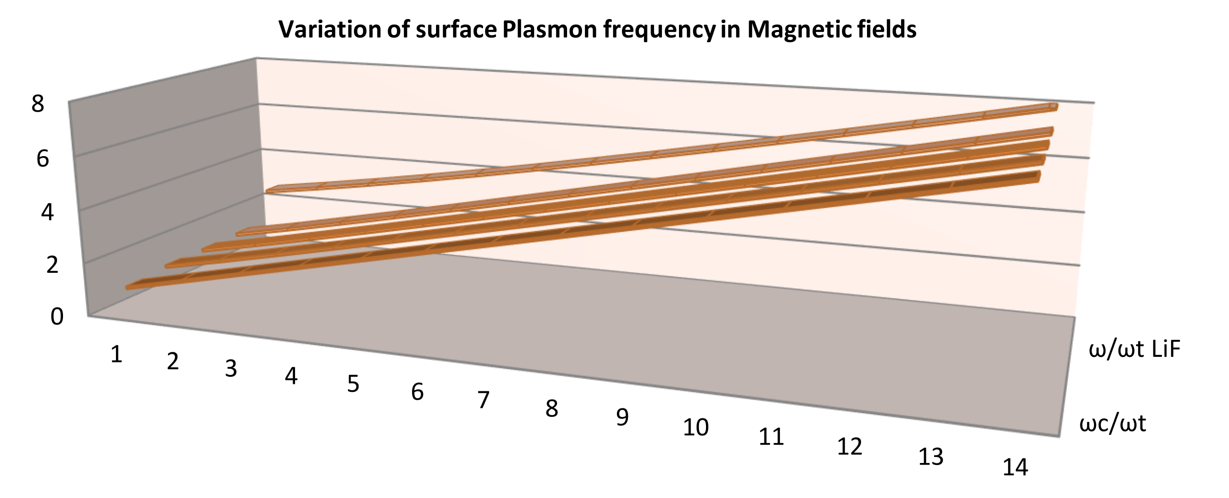
After simplification, we have:

$$\omega = \left(\frac{\omega_p^2}{\varepsilon_0 + \varepsilon_L} + \frac{\omega_c^2}{4} \right)^{1/2} + \frac{\omega_c}{2}$$

Now applicable equation is:

$$\frac{\omega}{\omega_t} = \left\{ \frac{\left(\omega_p / \omega_t \right)^2}{\varepsilon_0 + \varepsilon_L} + \frac{\left(\omega_c / \omega_t \right)^2}{4} \right\}^{1/2} + \frac{\omega_c / \omega_t}{2} \qquad (2)$$

The graph has been plotted for equation 2 for various chemical compounds which belongs to semiconducting groups.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ωc/ωt	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5
ω/ωt RbI	1.1661	1.6196	2.0926	2.5752	3.0632	3.5545	4.0478	4.5426	5.0384	5.535	6.0321	6.5297	7.0276	7.5257
ω/ωt NaBr	1.1879	1.6364	2.106	2.5863	3.0727	3.5627	4.0551	4.5491	5.0443	5.5403	6.037	6.5342	7.0318	7.5297
ω/ωt LiF	1.2414	1.6785	2.14	2.6146	3.0968	3.5836	4.0736	4.5656	5.0592	5.554	6.0495	6.5458	7.0425	7.5397
ω/ωt Carbon	2.5532	2.878	3.2284	3.6012	3.9931	4.4011	4.8224	5.2547	5.6962	6.1453	6.6008	7.0616	7.5269	7.996

Figure

Fig. shows the variation of ω_c/ω_t versus ω/ω_t for constant value of ω_p/ω_t for chemical compounds(RbI,NaBr,LiF and carbon atoms). It is seen from above fig that the value of lattice vibration frequency ratio increases gradually with increasing the value of cyclotron frequency ratio. It is also seen that the graph is very smooth and linear for the condensed material RbI. It is also seen linearity of the graph for the condensed material, i.e. NaBr is nearly equal to one. It is also seen from above fig. that the value of lattice vibration frequency ratio increases gradually with increasing the value of cyclotron frequency ratio. Moreover it is seen that the graph is smooth and linear for the condensed material LiF. The value of lattice vibration frequency ratio increases gradually with increasing the value of cyclotron frequency ratio. It is also seen that the graph is smooth and nearly linear for the condensed material Carbon.

It is seen that the graph is very smooth and linear variation of surface Plasmon frequency with respect to frequency of magnetic field produced by cyclotron when chemical compounds are place in this device. Now after observing by graph we find that Surface Plasmon frequency on surface of chemical compounds is 0.1355,0.1547,0.2029 and 0.17944 time lattice vibrations frequencies of RbI, NaBr, LiF and carbon molecules in absence of external magnetic fields. The slope of curve for different substances are 1.0173 for RbI, 1.0197 for NaBr, 1.0256for LiF and 1.1793for carbon molecules. It is seen that maximum slope of curve for LiF is calculated theoretically as compare to other substances i.e. surface Plasmons frequency changes rapidly as compare to other substances in presence of alternating magnetic fields produced by cyclotron device. Thus a LiF substance is much useful as other substances because its surface Plasmon frequency changes very soon in external sources.

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