Controlling surface plasmons with liquid crystal layer

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Surface plasmons are finding their use in a variety of application, for instance sub-diffraction limited imaging, bio-sensing, optical cloaking, spectroscopic measurements (e.g. SERS), guiding and manipulating the light, etc [1,2]. In this talk various ways of tuning and controlling plasmons with the help of liquid crystal layer (LC) will be reviewed. We shall also address our recent results on using liquid crystals to control plasmons in nano-structures including graphene ribbons. An advantage of plasmons in graphene compared for instance to plasmons in a gold film is a stronger mode confinement and lower propagation loss in the mid-infrared region [3,4]. One possible way to excite the surface plasmons is placing a periodic array of graphene nano-ribbons on top of a dielectric substrate. However once the system is fabricated with a given set of parameters (ribbons width, period of the structure, dielectric function of the substrate) it is not possible to change its optical properties. (It should be noted that a slight tunning of plasmons in graphene can be done via a gate voltage.) Liquid crystal is a uniaxial medium with optical axis (director) easily controlled by external stimuli. Combining the liquid crystals with plasmonic nanostructures one can achieve a tuning of plasmons [5]. Recently Franklin et al. used LC to actively tune the color generation on imprinted plasmonic surfaces [6]. In this talk we present our results on tuning the surface plasmons in graphene nano-ribbons by reorienting the director in a LC slab placed on top of the ribbons. We find that by applying a voltage to the LC layer it is possible to shift the graphene ribbons plasmonic notch and change its depths.

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References

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Speaker Biography

Victor Reshetnyak received M.S. degree in Theoretical Physics from Taras Shevchenko National University of Kyiv in 1980, Ph.D. and DSc degrees in Theoretical and Mathematical Physics in 1985 and 1994, respectively. Since 1998, he has been with the Theoretical Physics Department of Physics Faculty, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine, where he is a full Professor since 1999. Prof. Reshetnyak is a member of the International Liquid Crystal Society Board. He also is a member of Optics of Liquid Crystals meetings Advisory Board. He was awarded a National Academy of Sciences of Ukraine A.F. Prihot'ko prize "For studies of the physical background and applied aspects of liquid crystals photo-orientation" (2012).