Seminario

Optical modulation using field effect and charge accumulation in 2D materials and TCOs

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Abstract

Transition metal dichalcogenides such as MoS_2 have a large complex refractive index in the visible and NIR which can lead to strong light-matter interaction. A single layer of MoS_2 for example can exhibit an optical path length which is an order of magnitude longer than its physical thickness[1]. This can be used to create micro-optical elements such as lenses and diffraction gratings in from atomically thin layers[2].

Electrical tuning of the complex refractive index in these thin layers would lead to active devices. 2D TMDs have been shown to have a large field effect tuning of refractive index close to the exciton resonances[3]. The change of refractive index is unprecedented and over 50 times larger than what can be achieved in conventional electro-optic systems using quantum wells.

We are interested in combining strong absorption in deeply subwavelength complex refractive index films with active control using field effect tuning in TMDs and/or charge accumulation in transparent conducting oxides (TCO). The goal is to create low energy surface normal amplitude and phase modulators which could be used as pixels of new functional devices, such as modulators, beam steering arrays, tuneable filters, and thermal radiation control. The deeply subwavelength nature of the devices would allow for extremely fast switching and low energy devices.

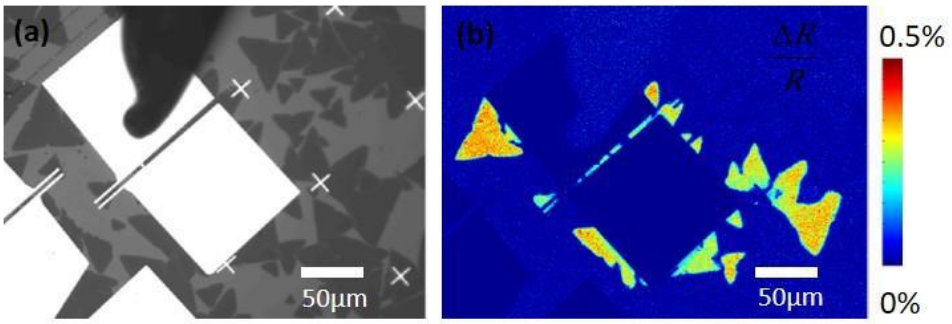

Figure 1: (a) Optical micrograph of top contacted CVD MoS2 on 300nm SiO_2 with highly p doped Silicon substrate as back gate **(b)** Differential refection image with 10Vpp bipolar square wave applied.

References:
[1] ACS Photonics 2017, 4 (12), 3130-3139.
[2] Light Sci Appl. 2016;5(3):e16046
[3] Nano Lett. ,17, 3613 (2017)

Martes, 7 de Marzo de 2023
Aula IV (Ed. Trilingüe) @ 12:00h