Surface-acoustic-wave-driven graphene plasmonic sensor for fingerprinting ultrathin biolayers

Raúl Izquierdo-López[1,2]
Rajveer Fandan[1,2], Alberto Boscá[1,2], Fernando Calle[1, 2], Jorge Pedrós[1,2]
[1]*Instituto de Sistemas Optoelectrónicos y Microtecnología, Universidad Politécnica de Madrid, Av. Complutense 30, Madrid 28040, Spain*
[2]*Departamento de Ingeniería Electrónica, E.T.S.I de Telecomunicación, Universidad Politécnica de Madrid, Av. Complutense 30, Madrid 28040, Spain*
raul.izquierdo@upm.es

Graphene supports surface plasmon polaritons (SPPs) in the mid-infrared range, a region of the electromagnetic spectrum that is key for the study of the composition of organic molecules via their vibrational fingerprint, which makes it an exceptional candidate for SEIRA spectroscopy [1]. In this work, we theoretically demonstrate the performance of a mid-infrared plasmonic biosensor where a surface acoustic wave (SAW) acts as a dynamic diffraction grating for far-field light coupling [2, 3], as illustrated in Fig. 1(a). A transfer matrix method (TMM) has been used to simulate the optical properties of a graphene/h-BN heterostructure on a piezoelectric substrate, while a coupled oscillators model (COM) is used to extract quantitative information about the presence of organic compounds on the sensor even when the interaction is too weak for a Fano pattern to appear, allowing films as thin as protein bilayers or peptide monolayers to be distinguished [4], as shown in Fig. 1(b).

References

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Figures

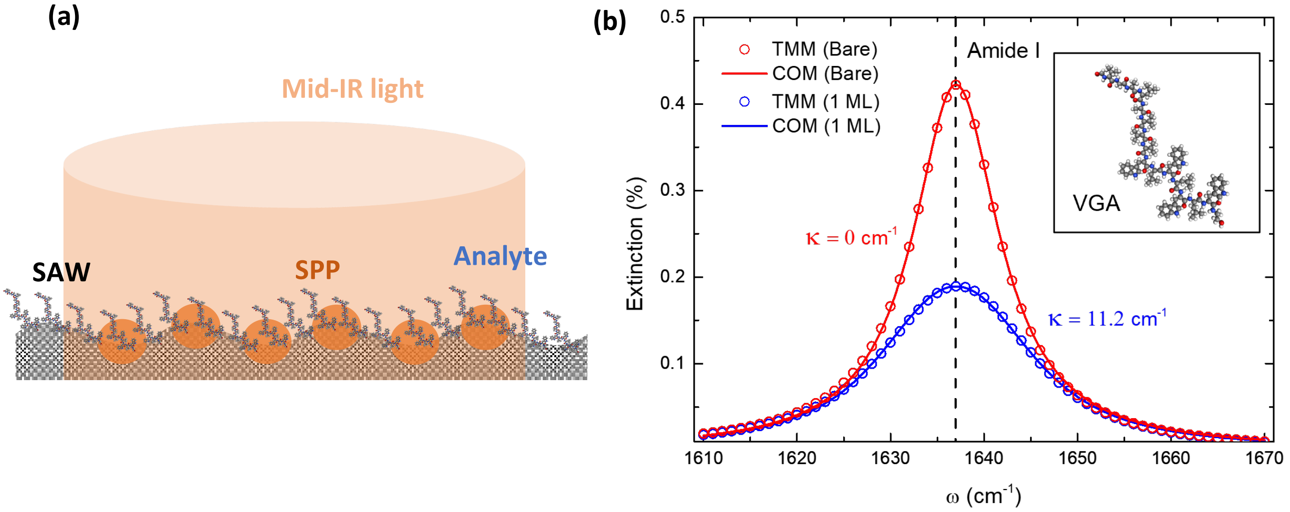

Figure 1: (a) Schematic of the plasmonic biosensor. **(b)** Optical extinction of the bare biosensor and covered by a valine gramicidin A (VGA) monolayer (ML) around the amide I absorption band. Note the agreement between the spectra calculated by the transfer matrix method (TMM) and the fit resulting from the coupled oscillators model (COM), that allows us to infer the presence of the analyte through the value of the coupling parameter κ, even in the absence of a Fano pattern.