

Tailoring the properties of the electromagnetic modes excited by Mid-IR fs pulses at the interface between Si and SiO₂ coatings by adjusting the thickness of the dielectric material

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A key issue in the use of high-power mid-infrared (mid-IR) laser sources for a plethora of applications is the investigation of the exciting laser-driven physical phenomena taking place in materials coated with dielectric films. Here, we present a theoretical investigation of the conditions for surface plasmon (SP) excitation on the interface between SiO₂ and Si and the influence of the film thickness on the SP features as such electromagnetic modes can initiate structuring on the interface. Our results manifested a striking impact of the presence and the coating thickness on the SP characteristics (i.e. periodicity, propagation length, decay length) (Fig.1) [1]. It is shown that the SP excitation can be tailored by changing the superstrate thickness which also determines the competition of the air and the dielectric in the SP characteristics. These remarkable predictions can be employed for the development of optical coatings and components for nonlinear optics and photonics for a large range of mid-IR laser-based applications.

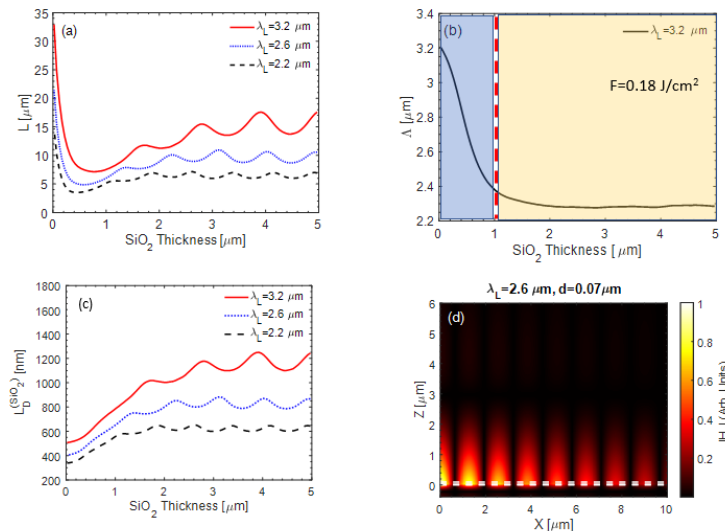


Figure 1: Properties of the electromagnetic modes on the interface between SiO₂ and Si.

References

[1] Tsibidis G.D., Stratakis E., 'Tailoring the ultrafast dynamics and electromagnetic surface modes on silicon upon irradiation with mid-infrared femtosecond laser pulses using SiO₂ coatings', Physical Review B 109, 184113 (2024).