

Low frequency (THz) radiation on periodic semiconductor structures

J. Gómez Rivas¹, M. Kuttge¹, P. Haring Bolivar², and J.A. Sánchez-Gil³

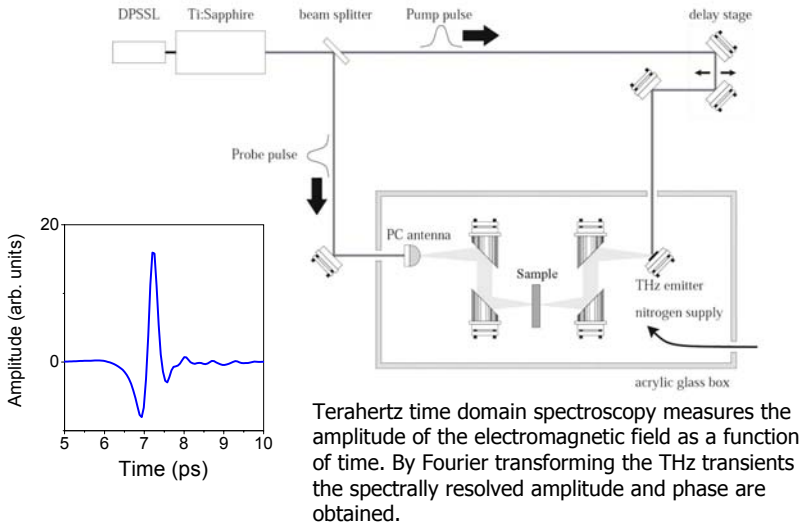
¹Center for Nanophotonics, FOM Institute for Atomic and Molecular Physics, Amsterdam, The Netherlands

²Institute of High Frequency and Quantum Electronics, University of Siegen, Germany.

³Instituto de Estructura de la Materia, Consejo Superior Investigaciones Científicas, Madrid, Spain
rivas@amolf.nl

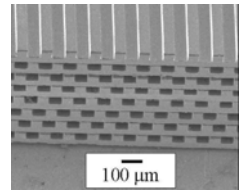
Terahertz radiation corresponds to the far-infrared region of the electromagnetic spectrum. The ease in detecting not only the amplitude but also the phase of broadband THz pulses opens the possibility to interesting fundamental studies. We have investigated the dynamic propagation of THz pulses through 3D photonic crystals observing a significant decrease of the group velocity at the edges of the stop gap and superluminal tunneling in the gap. We have also investigated the propagation of surface plasmons polaritons on gratings structured in doped silicon, demonstrating the feasibility of low frequency plasmonics with semiconductors.

Terahertz time domain spectroscopy

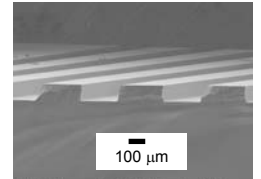


Photonic crystals and surface plasmon gratings

3D photonic crystals (woodpiles) fabricated by structuring and piling thin wafers of undoped Si ($\epsilon = 11.6$, no absorption).



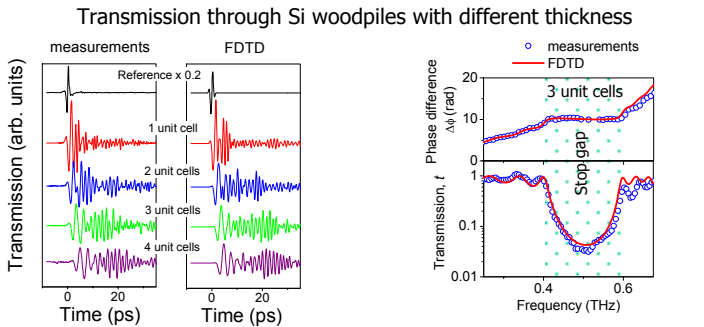
Gratings for surface plasmon polaritons SPPs in wafers of doped Si.



SPPs are electromagnetic waves propagating at the interface between a dielectric and a metal. Doped semiconductors have a metallic behaviour at THz frequencies.

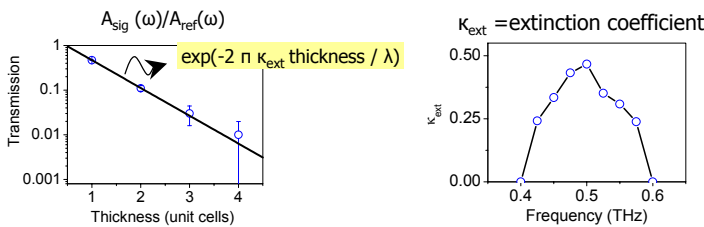
THz photonic crystals

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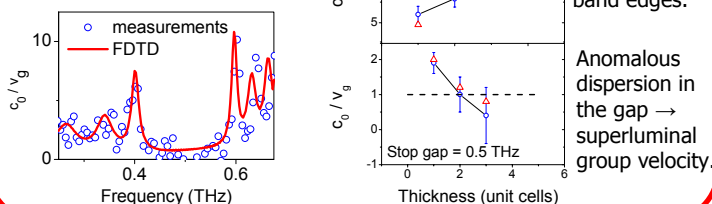
Fourier transform

$$T(\omega) = [A_{\text{sig}}(\omega)/A_{\text{ref}}(\omega)] \exp[-i \Delta\Phi(\omega)]$$



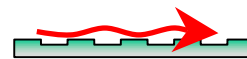
$$t_g = \partial\Delta\Phi / \partial\omega + t_0 \text{ time group delay}$$

$$V_g = L/t_g \text{ group velocity}$$

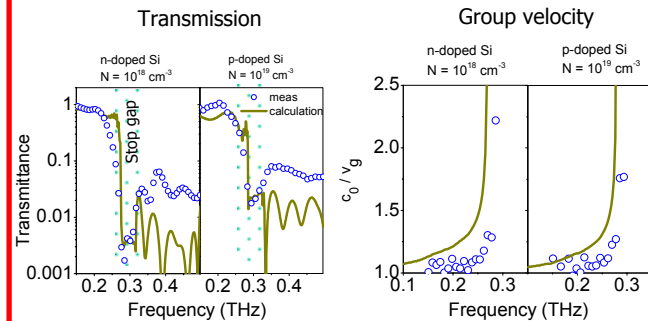
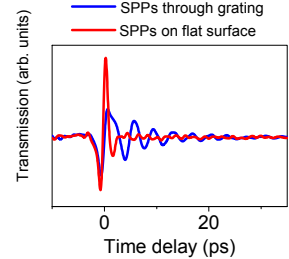


SPPs on semiconductor gratings

Phys. Rev. Lett. 93, 256804 (2004)



30 periods
SPPs are bounded to the surface of the conductor and are scattered by the corrugation.



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