Thermal Excitation of Broadband and Long-range Surface Waves on SiO_2 Submicron Films

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Following previous theoretical works uncovering the possible existence of broad band surface electromagnetic modes in thin films [1, 2], we have measured and calculated the far-field thermal emission of a submicron SiO_2 layer with a diffraction grating deposited itself on a metallic layer from near- to far-infrared frequencies as shown on Fig. 1. Thermally excited Zenneck surface waves, Surface Phonon Polaritons and guided surface waves were detected in the 882 cm^{-1} to 3725 cm^{-1} frequency range by means of Fourier transform infrared emission spectroscopy. The dispersion relation and spectral coherence length - found as large as 500 µm - are in good agreement with theoretical and numerical expectations. Optical and thermal applications are envisioned due to the photon-like behavior and the large propagation length of the observed modes. Those waves are indeed likely to open an unknown but very efficient heat channel, which can even predominate over heat conduction [3].

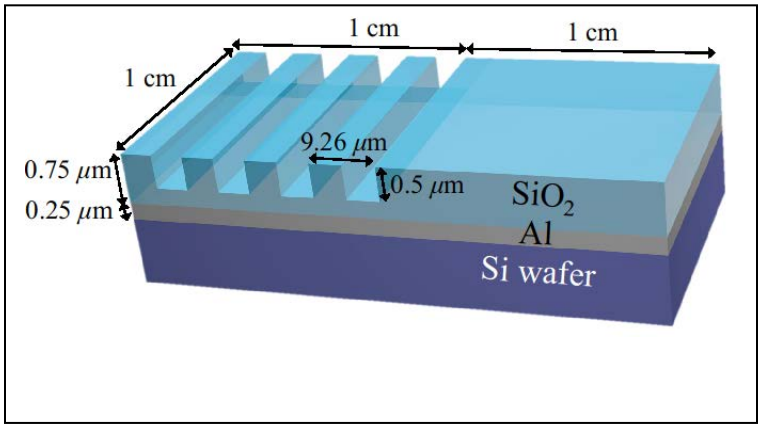

Fig. 1: Sample consisting of a SiO_2 layer deposited on an aluminum layer with a diffraction grating designed to detect thermally excited surface waves in far field.

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[2] F. Yang, J. R. Sambles, and G. W. Bradberry, *Phys. Rev. B.* **44**, 5855 (1991).

[3] D. A. Chen, A. Narayanaswamy, and G. Chen, *Phys. Rev. B.* **72**, 155435 (2005).