Supplementary Information

Mid-Infrared Plasmonic excitation in Indium Tin Oxide micro-hole arrays

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Optical characterization of ITO unpatterned films.

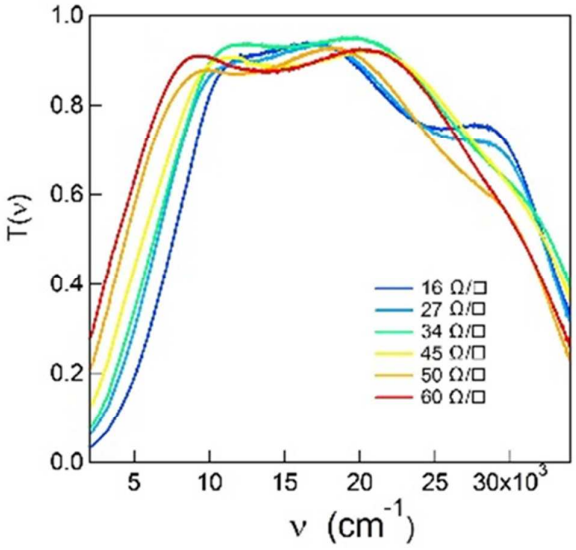

Figure S1. Infrared transmission spectra of ITO unpatterned films with different sheet resistance from 16 to 60 Ω/□ growth on glass substrate.

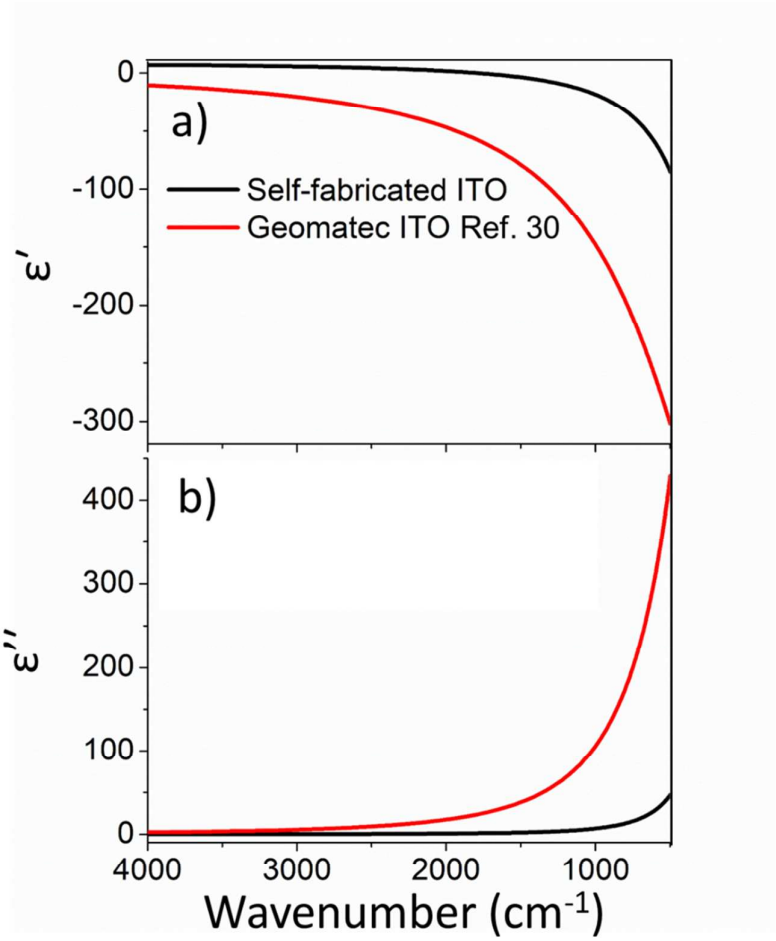

Figure S2. (a) Real (ε_1) and (b) Imaginary (ε_2) parts of the complex dielectric function of self-fabricated ITO thin film sputtered at RT by a RF magnetron system and literature data (ref. 30 in the main text) related to Geomatec Co. Ltd. ITO produced by using the DC magnetron sputtering method. The above mentioned ITO films are characterized by two different plasma frequences, 5400 cm^{-1} and 16700 cm^{-1}, respectively.

Numerical simulation of a periodic hole array.

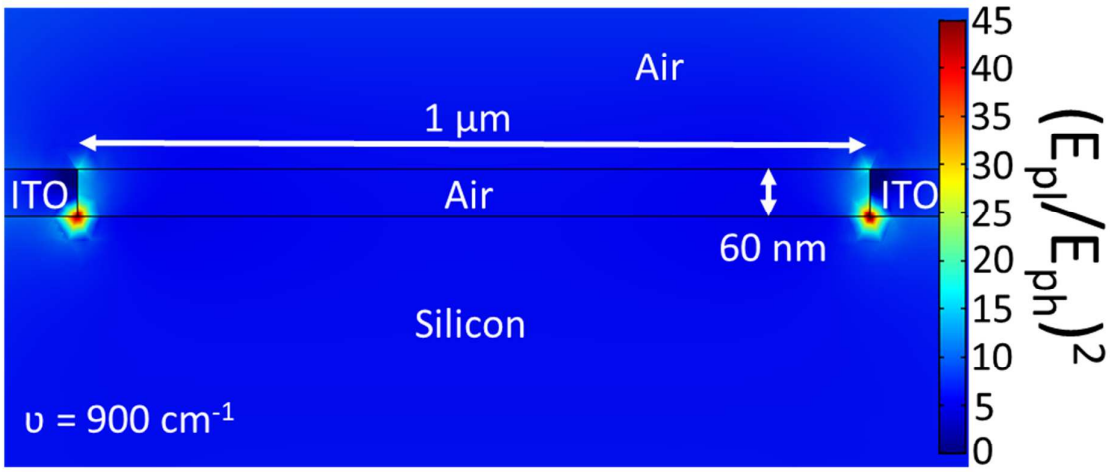

Figure S3. Numerical calculation of the near-field enhancement distribution for a periodic hole array with p = 2 µm.

Morphological analysis of patterned ITO films.

Figure S4 shows the presence of residual material at both ITO/air and ITO/Si interfaces. More in detail, Figure S4a shows a portion of the rim with an amount of residual material triggering electron scattering as will be also reported by the Referee in the next comment. We attempted to determine the material composition of such rims edges in several ways including Synchrotron Infrared Near-Field Spectroscopy (SINS), and although we can confirm that hole edges are raised (Figure S4a), we couldn't confirm the edge material to be ITO or PMMA left after the lift-off step.
Concerning the residual material at the ITO/Si interface, by analysing the top-view SEM image of patterned ITO (Figure S4b) we can note a not uniform white texture in the region between the holes. A high magnification tilted-view SEM (Figure S4b) exhibits small areas where the ITO film is randomly raised (bumps) and not flat, as it has been deposited over PMMA nanoparticles with a thickness up to 20 nm as confirmed by atomic force microscopy (AFM) image of Figure S4b. Nevertheless, we observed reproducibly PMMA signatures in the spectra of Figure 2 of the main text. Thereby, it seems reasonable to presume that such spectral signatures derivate from these small PMMA residues present under the ITO thin film also in proximity of the patterned holes, due to a non-optimal positive tone resist development step.
From results of Figure S4 we state that not uniform PMMA residues are present at the ITO/Si interface and probably at ITO/Air one and that the PMMA amount on samples is very low.

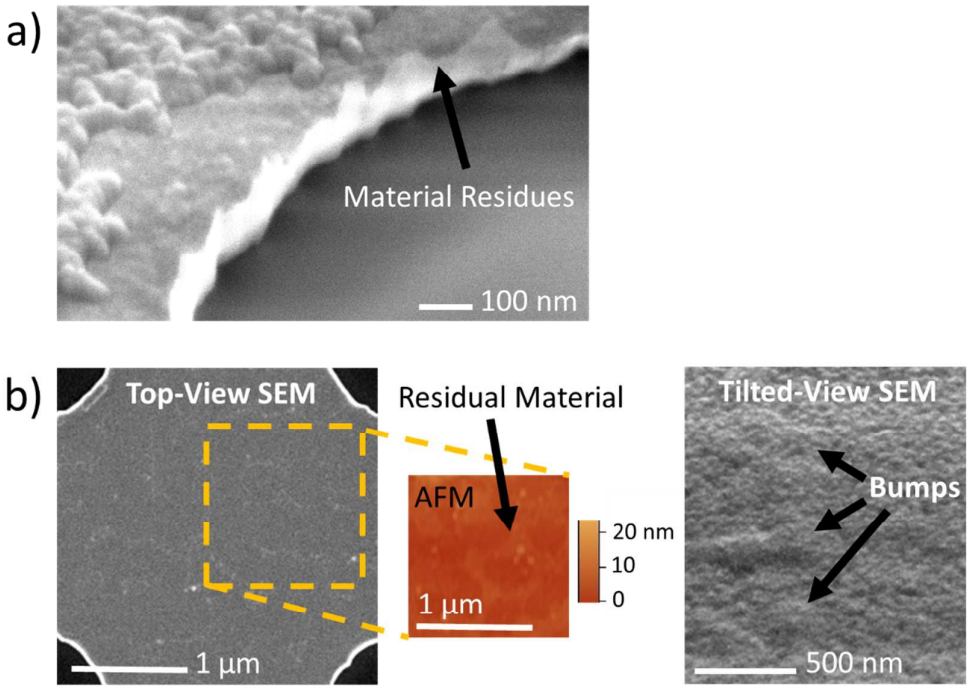

Figure S4. a) Top-view SEM image of the rim portion evidencing residual material on top of it b) SEM image of the region between the holes. The white texture, also evidenced by AFM analysis, emphasizes the presence of residual material. High magnification tilted-view SEM image shows the presence of bumps with ITO grains on top of them.