# Free standing metal aperture array acting as a variable bandpass filter in the THz region

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This work reports on the extraordinary THz transmission properties of shape optimized metallic subwavelength aperture arrays, and its dependence upon incident beam angle. The resonant frequency of the aperture array has been shown to vary between 0.82 – 0.97 THz due to incident angle alone, while maintaining excellent (>85%) peak transmission.

Extraordinary optical transmission (EOT) through a subwavelength aperture array was first reported at THz frequencies in 2003 (J. Gómes Rivas, C. Schotsch, P. Haring Bolivar, H. Kurz, "Enhanced transmission of THz radiation through subwavelength holes", Phys. Rev. B, 68, 201306(R), 2003). The underlying physics of this phenomenon is still not fully understood. However, it is widely accepted that surface plasmon polaritons, which exist at the interface between metal and air, play a role in the effect.

The periodic metal aperture arrays reported here were created using standard lithographic and electroforming techniques. A seed layer of titanium was evaporated upon a two-inch silicon wafer followed by a 100 nm gold seed layer to act as the electrical contact for electroforming. Once electroformed, the copper foil was peeled away from the seed layer creating a free standing array. SEM images of the photoresist array pillars and resultant free standing copper array are shown in Fig 1.

THz characterisation has been undertaken using both continuous wave and pulsed techniques. A comparison is made between transmission data obtained from a cw Vector Network Analyser, with an optimum working range of 0.77 – 1.07 THz and a pulsed, broadband (3 THz), Time Domain Spectroscopy (THz- TDS) system.

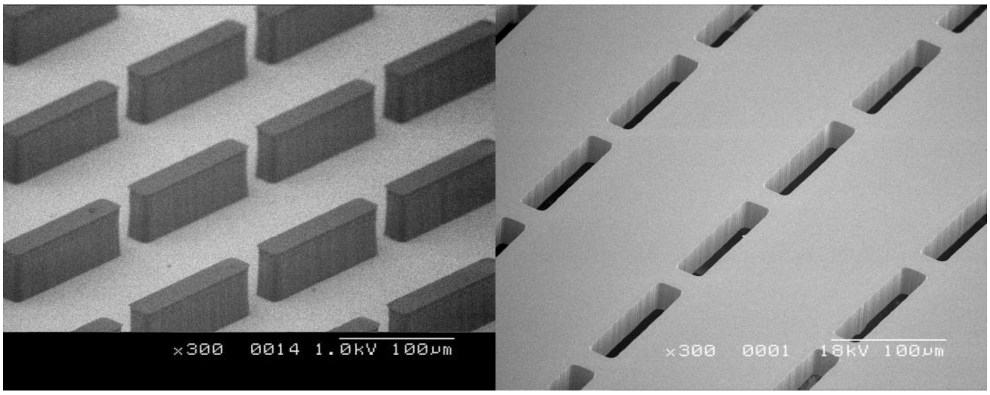


Fig 1. SEM image of AZ9260 photoresist pillars and free standing Cu aperture array.