THz Multi-frequency Resonance Filter

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***Abstract*—The transmission characteristic of a two-dimensional array of rectangular holes was examined theoretically and experimentally in the THz frequency range. The structure under consideration was found to act as a multi-frequency resonance filter whose frequency response of transmission depends on the periodicities and filling material of the structure.**

I. Introduction And Background

TRANSMISSION of electromagnetic waves through subwavelength apertures has been attracting a great deal of interest since the first observation of extraordinary transmission [1]. Though the main concern in this field has been clarifying the origin of the enhancement [2]-[4], there has also been an effort to interpreting the assembly of subwavelength apertures as an effective medium [5]-[7]. This assembly can be regarded as a plasmonic medium [5] or dielectric medium [7] depending on its basic elements. The latter originates from the equivalence between the transmissions of TEM mode through a free-standing metallic slit array and a dielectric medium which has a constant index of refraction [7].

II. Results

Here, a thick metallic slab with two-dimensionally periodically perforated micro-waveguides is proposed as a multi-frequency resonance filter in the terahertz frequency regime. This structure has been fabricated using Deep Etch X-ray Lithography followed by nickel electroforming. Figure 1 shows one of the fabricated nickel samples with PMMA in it.

The transmission spectra of each sample was obtained by placing it in a THz-TDS system spanning from 0.2 to 2THz. Fig. 2 shows both the numerical and experimental transmission spectra of the sample in figure 1. Since the fundamental waveguide mode of each micro-waveguide governs the transmission of incident light through the whole structure [8], several resonance peaks are observed in the numerically obtained transmission spectrum. Those peaks appear from the cutoff frequency of each waveguide and disappear above the Rayleigh minimum and each peak corresponds to the different orders of waveguide resonances.

Though the resonance peaks are clearly observed in the transmission spectrum from numerical simulation in figure 2, those peaks can not be clearly seen in that of the experimental result. This is due to the extremely narrow width of each resonance peaks and can be solved by increasing the sample coverage of each hole. Samples are being prepared to obtain better transmission spectrum.

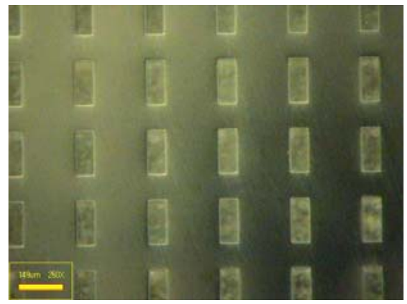

Fig. 1. Microscope image of a LIGA-fabricated sample

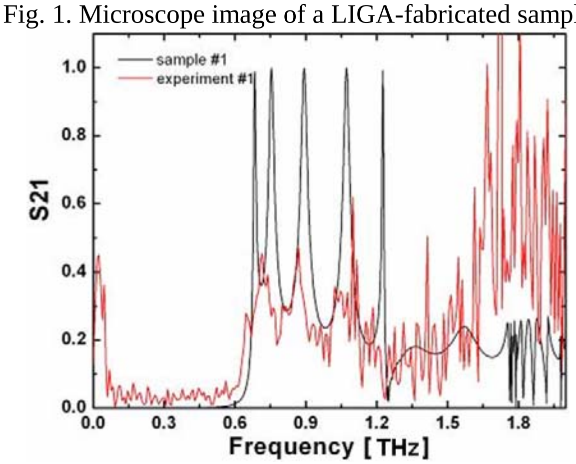

Fig. 2. Comparison of theoretical and experimental transmission spectra

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