THz Mixtenna Chips and Quasi-optical Mixers for Focal Plane Imaging Applications

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***Abstract*—THz mixtenna chips and quasi-optical mixers for focal plane imaging applications are presented. Firstly, the THz Schottky diodes with the cutoff frequency of 3.2 THz are designed and fabricated. Then, the mixtenna chips are designed, by extending the two pads of the diode to a differentially-fed antenna. Finally, the 325 GHz quasi-optical mixer and mixer array, which consist of the mixtenna chip integrated with the silicon lens, are studied and measured.**

I. INTRODUCTION

THE THz focal plane array is the key components for THz imaging applications, which could detect radiations from different directions simultaneously. To make the focal plane array more sensitive and more compact, quasi-optical mixers are studied, which consist of mixtenna chips [1] integrated with the silicon lens [2].

II. RESULTS

The key device on the mixtenna chip is the Schottky diodes. Fig. 1 shows the Schottky diodes designed for the mixtenna chip, which is fabricated by THz GaAs Schottky diode process. The estimated cutoff frequency is 3.2 THz.

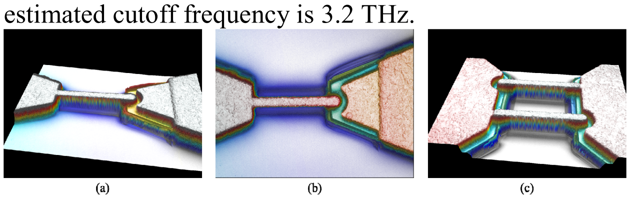

Fig. 1 Photograph of the Schottky diode(s) obtained by 3D profiler.

By extending the two pads of the Schottky diodes to a differentially-fed antenna, the mixtenna chip could be realized, as shown in Fig. 2. The dipole log periodic antenna (DLPA, Fig.2 (a)), log-periodic antenna (LPA, Fig.2 (b)) and spiral antenna (SA, Fig.2(c)) are used, all of which are broadband.

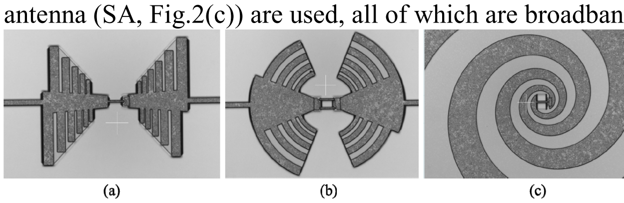

Fig. 2 Photographs of the mixtenna chips: (a) DLPA with single diode; (b) LPA with antiparallel diodes; (c) SA with single diode.

Fig. 3 shows mixtenna array chip, including the 1×4 array, 2×2 array and 3×3 array. All of them are based on log periodic antenna with a single Schottky diode, and can operate as fundamentally mixer array.

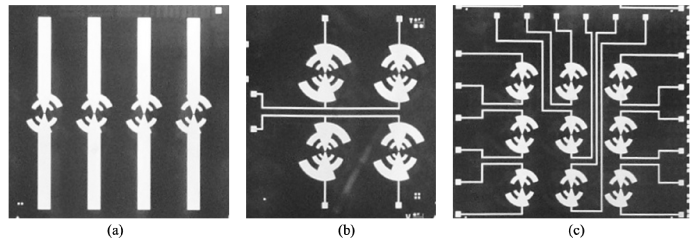

Fig. 3 Photograph of the Mixtenna Arrays: (a) 1×4 Array; (b) 2×2 Array; (c) 3×3 Array

To improve its directivity, the mixtenna chip and the array are integrated with a silicon lens, as shown in Fig. 4 (a) and (b) respectively. Fig.4 (c) shows the operation principle of the so called quasi-optical mixer. Both the RF and LO are fed from space, which will be bunched by a PTFE lens.

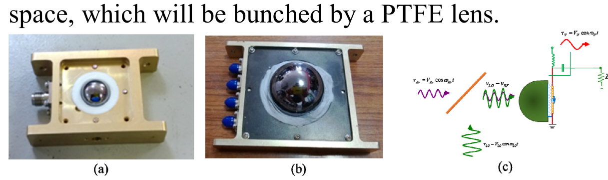

Fig. 4 (a) The operating principle of the quasi-optical mixer; (b) The schematic for feeding the RF and LO; (c) The platform for characterizing the quasi-optical mixer(s); (d) The quasi-optical mixer; (e) The quasi-optical mixer array.

Fig. 5 shows the measured results of the quasi-optical mixer and mixer arrays. The conversion loss of the QOM is between 16 dB and 22 dB from 320 GHz to 330 GHz. The typical conversion losses of the mixer array are between 19 dB to 30 dB from 320 GHz to 330 GHz. The beam width is less than 2 deg at 325 GHz.

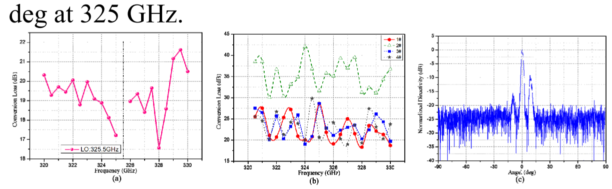

Fig. 5 Conversion loss of (a) the quasi-optical mixer and (b) mixer array. (c) The radiation pattern of the quasi-optical mixer.

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