Design and experiment of a noval frequency scanning grating array antenna operating at 0.3 Terahertz band

Shichao Li[(1)(2)], Chao Li[(1)], Xiaojuan Zhang[(1)], and Guangyou Fang[(1)]
(1) Key Laboratory of Electromagnetic Radiation and Sensing Technology, Institute of Electronics, Chinese Academy of Sciences
(2) University of Chinese Academy of Sciences

A novel frequency scanning grating array antenna operating on the frequency band of 0.235THz~0.33THz is designed and investigated by experiment. The array antenna system consists of a planar grating reflector, a feed horn and a thin lens adjusting the beam waist of the illumination Gaussian wave. The planar grating reflector is composed of a planar periodic binary grating array and a single-layer substrate. The planar periodic binary grating array is characterized by the two-dimensional periodic unit cells, with which are elaborately designed and composed by three ‘I’ shape patches defined as ‘subcells’. The planar structure brings much convenience of fabrication and potency of extending to a higher frequency. The grating reflector transfer the incident wave into the specular wave and the first higher order diffracted wave serving as the frequency steering beam. To suppress the specular beam and obtain a high diffraction efficiency, the diffraction enhancement concept is introduced to the design of the subcells. For the quasi-parallel incidence, each subcell brings an abrupt phase shift between the diffracted wave and the incident wave. The diffraction enhancement concept focuses on the in-phase superposition of the diffracted wave from each subcell. Both the frequency tuned beam steering and the high diffraction efficiency characteristics have been verified by the quasi-optical measurements at the 0.3THz band. The experiment shows a scanning range of 28.1° over the frequency band of 0.235THz~0.33THz. The diffraction efficiency achieves around 90 percent with the specular beams inhibited by 10dB below the scanning diffraction beam. The proposed beam-steering antenna can be used for THz imaging with high frame rate.