Integrated Micro-Lens Antennas for THz Heterodyne Receivers

Maria Alonso-delPino [*], Cecile Jung-Kubiak[1], Theodore Reck[1], Choonsup Lee[1] and Goutam Chattopadhyay[1]

[1]*Jet Propulsion Laboratory, Pasadena, 91109, USA*
[*]Contact: maria.alonso@jpl.nasa.com

Abstract—Most of astrophysics and planetary missions at terahertz frequencies require a multi-pixel array of receivers in order to reduce the acquisition time of the observations. At the same time, the power, mass and volume of the instrument needs to be reduced. Silicon micromachining is a technology that enables the integration of the heterodyne receiver front end in just a few silicon wafers. The volume, mass and loss reduction of these approach compared with split block metal machining technology is considerable. An antenna with high efficiency and that has seamless integration with a silicon wafer stack is necessary to successfully develop these heterodyne instruments.

This work presents the development of integrated micro-lens for frequencies up to 1.9 THz. The antenna is composed of a waveguide based feed with an iris and a Fabry Perot cavity to enhance the directivity of the feed. On top lies a shallow silicon lens. The aperture efficiency of this antenna is higher than 80% which makes them suitable for tight inter-pixel array stacking. The bandwidth is around 15%, sufficient for most Schottky based heterodyne receivers, and a cross-pol level below -25 dB. Moreover, the feed and lens can be fabricated using silicon micro-machining processes and can be vertically integrated with the rest of the receiver. Two prototypes have been built and evaluated at 1.9 THz: one with an aperture of 2.6 mm and a measured directivity of 33.2 dB and the other one with an aperture of 6.35 mm and a measured directivity of 41.2 dB. The technology development required to implement this antenna at 1.9 THz will be presented here, in terms of design fabrication, system integration and performance evaluation.