A 370GHz on-chip Rectangular-waveguide-based Slot Antenna

Saman Jafarlou*, Peyman Nazari, and Payam Heydari
Department of Electrical Engineering and Computer Science
University of California Irvine, CA, 92697, USA
sjafarlou@uci.edu, pnazari@uci.edu, payam@uci.edu

Exploiting THz frequency range is attracting more attention due to the emerging demand for non-destructive testing and high resolution imaging systems. Antenna, as an integral part of such systems, plays a crucial role in several major performance parameters including sensitivity and efficiency of these transceivers. Furthermore, lossy transmission lines and off-chip interconnects leaves on-chip antennas as the only viable solution, particularly considering the miniaturized antenna foot-print at THz frequency band. Presented is an on-chip rectangular-waveguide-based slot antenna operating at 370 GHz. This antenna is realized using metal layers of a standard CMOS process stacked within SiO_2 dielectric on top of silicon. The antenna consists of a rectangular cavity with a slot etched on the top layer, while, the bottom metal layer serves a solid ground plate which eliminates the substrate leakage and obviates the need for silicon lens. Waveguide sidewalls are implemented by vertical stack of vias reliably acting as solid walls. The cavity is designed to resonate in TE110 mode at the desired frequency which leads to maximum directivity compared to the higher order modes. FEM simulations, carried in ANSYS HFSS, results show the -10dB bandwidth of 10 GHz with 15% radiation efficiency and 0 dBi peak gain.

A prototype of this antenna is fabricated in TowerJazz SiGe BiCMOS 130nm technology and measured using WR2.2 frequency extenders provided by Keysight Technologies. To excite the antenna by GSG probes, a CPW to rectangular waveguide transition precedes the antenna. The radiation pattern and peak gain of the probed DUT are measured in transmitter mode and are in good agreement with the simulation results.