Low-Cost and High-Gain Multi-Step Grading Antenna for Millimeter-Wave Applications

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The dielectric antennas have received great attention in millimeter wave applications due to their advantages of low-cost, low profile, lightweight, high radiation efficiency, and compatible integration with current Silicon microfabrication technologies. This paper presents the optimization of a dielectric annular multi-step grating antenna to work in the W-Band as show in figure below. The antenna will be fabricated using the Si-based technology platform. This technology platform is capable of integrating passive components and active components along with high efficiency dielectric antenna on one platform. The proposed antenna is a half-disk with annular multi-step grating. The antenna is feed via a dielectric image guide (DIG) fabricated of high resistivity Si. The other end of the DIG has a tapper section that will be inserted into a standard metallic wave-guide WR10. WR10 will be excited with the dominant mode that will couple to the DIG through the taper section to minimize the return loss. We performed a parametric sweep of the physical dimensions of the dielectric grating antenna in order to optimize the performance in terms higher gain and better efficiency while decreasing the over all size of the antenna. We incorporated only one annular ring with multi-step grating rather than using multi-rings with only on step. The simulated gain of the antenna is 18.1 dB at 97 GHz with radiation efficiency better than 95%. While the gain of the new design was increased by 25% from previous design, the over all size was decrease to 25% of the original designed antenna.