3D Printed Monolithic W-Band Slotted Waveguide Array Antenna

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High gain, radiation efficiency and power capability with simple geometric structure makes slotted waveguide array antennas very attractive in many applications. Commercial slotted waveguide arrays, which can be made from brazed, machined plates and sheets with precision machining process are metallic structures. However, typical machining process has relatively low precision and higher manufacturing cost for millimeter wave frequency. An alternative option for reducing manufacturing complexity and lower the cost is 3D printing technology. Using 3D printed dielectric structures with metal plating instead of conventional metal manufacturing process allows us to realize slotted waveguide array antennas with lower cost. Since 3D printed waveguide cost is based on polymer volume, complex and customized designs does not add additional cost.

This work presents design and fabrication of monolithic W-band slotted waveguide array antenna by polymer jet printing. The array consists of 10 slotted waveguides and each waveguide has 10 radiating slots. Center-fed coupling waveguide is designed to excite the array. Radiating and coupling slots are optimized to achieve low side lobe level. In order to plate inner and outer surfaces of the complete monolithic structure, non-radiating slots are added on the top and bottom surface of the array. Printed monolithic slotted waveguide array antenna is cleaned manually first and then complete cleaning is done with a sonic cleaner. The final designed antenna has a 27 dB gain and a -22dB side lobe level at 79 GHz. The effective aperture efficiency is about 60%.