Micro-coaxial Cavity-Backed Antennas and Arrays

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The development of RF MEMS components over the past decade have contributed to the advance of enabling fabrication technologies for future, high-performance millimeter and sub-millimeter electromagnetic systems. Among these, special place belongs to the techniques aimed at building μ-coaxial lines and related components such as antennas, hybrids, and resonators. Though circular coaxial lines are desired (lowest loss), the micromachining fabrication is limited to the manufacturing of rectangular coaxial lines (RCLs). Low loss, wide single TEM and non-dispersive mode bandwidth, high turn ratios, possibilities for seamless single/multi-level integration with other passive and active components are just a few appealing properties associated with RCLs.

In this work, we demonstrate *Ka*-band cavity-backed patch antenna and compatible linear arrays built using a sequential micro-fabrication technique, now known as *PolyStrata*™ process. This printed circuit board like process is capable of creating micro-coaxial structures, compatible components and all passive sub-systems with high quality performance that includes ultra-low loss, cross-talk, and dispersion, along with high wafer and lot yields. Demonstrated here is a single antenna element with 8% bandwidth and 97% radiation efficiency at 30GHz. Rectangular μ-coaxial line based combining networks are either monolithically or in hybrid fashion integrated with radiating elements. To reduce the array footprint a new topology of power dividing network is developed. This combining network has height ½ that of the array and feed lines do not route through the antenna elements. Individual array components are designed using full-wave methods based on the finite element and finite integration methods. To assess computationally the array performance, an equivalent cascaded circuit model comprised of the representative network parameters for each functional component is created and overall losses for each scanning condition are determined.