Gain and Efficiency Enhancement of mm-Wave On-Chip Antennas Through Artificial Magnetic Conductors

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Abstract

The emerging applications at millimeter wave frequencies have helped to achieve true System-on-Chip solutions by bringing the antennas on the Integrated Circuits (ICs that are also commonly known as chips). This is because the antenna sizes at these frequencies are small enough for practical on-chip realization. Though, there are a number of benefits of putting an antenna-on-chip (AoC), such as monolithic integration resulting in compact systems, and lower cost due to mass manufacturing in standard CMOS processes, etc, the major issue is dealing with silicon substrate's high conductivity and permittivity (resulting in poor radiation efficiency). Many off-chip techniques have been shown, such as etching the silicon substrate underneath the antenna, enhancing the resistivity of the substrate, and integrating a superstrate or lens, but all these techniques add processing steps, and eventually the cost of realization. A promising approach is to realize Artificial Magnetic Conductors (AMC) underneath the AoC to provide isolation from the lossy Si substrate as well as have in-phase reflections from the AMC. This talk describes AMC design steps in an on-chip environment and shows how it can be used to boost AoC radiation performance. Further, it also shows innovative techniques for AMC thickness reduction to make it more suitable with the traditional CMOS stack-ups.