Antenna Design for a 1 THz Source in SiGe-BiCMOS Technology

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Historically, the THz spectral region has been limited to high-end applications because of the lack of low-cost technologies capable of generating sufficient power. One field that is still widely underdeveloped with respect to the potential commercial applications of THz technology is wireless communication, with the promise of terabit-per-second indoor links. However, for this scenario to become realistic, room-temperature, low-cost integrated THz sources should become available. Silicon technology, especially complementary metal-oxide semiconductor (CMOS) and Bi-CMOS, has potential to dramatically reduce cost, size and complexity of THz systems and therefore greatly expand the use of the THz spectrum for commercially viable applications.

In this work, we describe the development of a 1.08 THz source integrated in 90 nm SiGe-BiCMOS technology, giving emphasis to the radiating part. An antenna array has been designed, composed by 8 (2x4) dipoles that are electrically connected to realize the connected-array concept (Fig. 1(a)). Artificial dielectric layers are included between the radiating dipoles and the ground plane to increase the bandwidth and the total efficiency. The simulated performance exhibits 25% bandwidth (defined as S11< –10 dB) from 0.95 to 1.2 THz, with very high total efficiency (>75%). The array is used as feed of an hyper-hemispherical lens, to obtain radiation patterns with high directivity.

The main critical aspects that had to be addressed during this work are the maximization of the output power from each frequency multiplier chain driving the antenna elements, the insurance of a low phase variability between the different chains and the efficient extraction of the radiation from the chip. Finally, the characterization of the performance from the integrated source prototype (Fig. 1(b)) at these high frequencies required an ad-hoc near-field measurement setup.

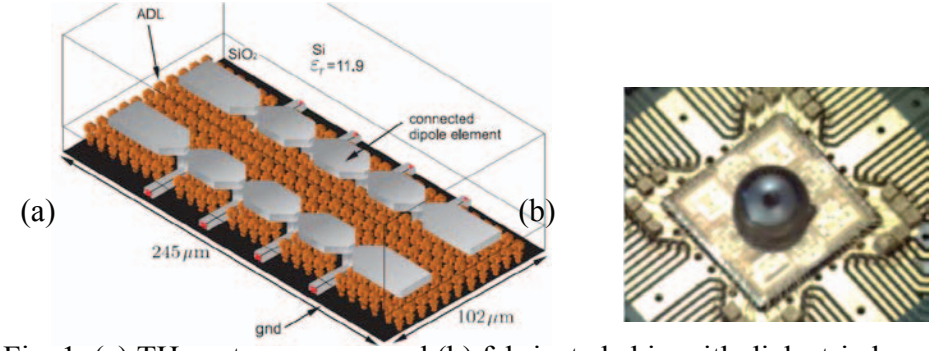

Fig. 1. (a) THz antenna array and (b) fabricated chip with dielectric lens.