Transistors for fast logic circuits: what we have learned from InP-based HBTs

Mark Rodwell, University of California, Santa Barbara

To inform work on InAs/AlSb transistors and fast logic, experience gained with InP-HBTs is valuable. Logic speed is only weakly determined by transit delays, ft and fmax, but strongly determined by depletion capacitance charging through load and base resistances. Key to fast logic are high current density, low voltage swing, low emitter resistance and minimal excess collector capacitance. Emitter resistivity is the key parameter limiting further logic speed improvements in InP-HBT. Regarding power dissipation, power is reduced through reduced supply voltages, but logic swing and interconnect length are equally relevant. Low power logic demands (besides low base bandgap) low emitter resistance, small junction areas, and a small device footprint leading to short interconnects.