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Transistor breaks through 600GHz barrier

12 April 2005

Scientists at the University of Illinois at Urbana-Champaign achieve 604 GHz transistor speed by compositionally grading the collector, base and emitter.

University of Illinois at Urbana-Champaign (UIUC) researchers have broken the transistor speed record with a pseudomorphic HBT operating at 604 GHz (see Applied Physics Letters article).

Milton Feng

The InP/InGaAs transistor, which was produced by Milton Feng and Walid Hafez, contained a compositionally graded collector, base and emitter to reduce transit time.

“Pseudomorphic grading of the material structure allows us to lower the bandgap in selected areas,” explained Feng. “This permits faster electron flow in the collector and improves the current density.”

According to Feng the modifications to the transistor will help researchers produce a terahertz transistor: “To achieve such speed in a typical HBT, the current density would become so large that it would melt the components. In our pseudomorphic HBT, we can operate at higher frequencies with less current density.”

The pseudomorphic HBT, which was produced at the UIUC Micro and Nanotechnology Laboratory, was grown by MBE on InP substrates and fabricated using an all wet-etch process. The device, with a 0.4 x 6 µm emitter, achieved a fT value of 604 GHz, and an associated fmax of 246 GHz, at a collector current density of 16.8 mA/µm2.

Transistors operating at higher speeds could lead to faster computers, more flexible and secure wireless communication, and improved electronic combat systems.