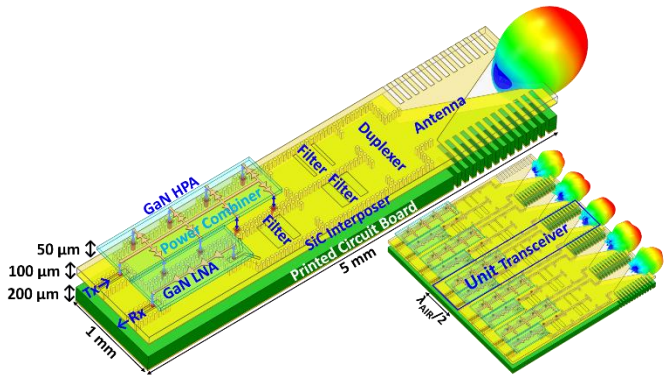
Heterogeneous Integrated Sub-THz Transceiver Frontend

James C. M. Hwang
Cornell University, Ithaca, New York 14853 USA



Heterogeneous integration of different kinds of chiplets on an interposer has been developed for digital and memory applications. Heterogenous integration for RF applications is just emerging. In this case, with only a few input/output channels, there is plenty of room in the bulk of the interposer for passives such as combiners, filters, duplexers, and antennas that are much more efficient than their thin-film counterparts. This makes it possible to have a complete RF frontend on a chip (interposer). In particular, at sub-THz frequencies (100-300 GHz), substrate-integrated waveguides (SIWs) can have much lower loss than microstrip or coplanar transmission lines. With the signal fully enclosed in the SIW, transmit and receive channels can be placed next to each other without crosstalk. Thus, a linear phased array, with each transceiver confined in a half wavelength, can be fabricated on the same interposer. In turn, the interposers can be stacked to form a 2D array. These points will be illustrated through the GaN-on-SiC technology. However, similar heterogeneous integration approaches are applicable to other device technologies and interposer materials.

James C. M. Hwang received the B.S. degree in physics from National Taiwan University, and the M.S. and Ph.D. degrees in materials science and engineering from Cornell University. He is currently a Professor at the Department of Materials Science and Engineering, Cornell University. Prior to that, he spent most of his academic career with Lehigh University, after years of industrial experience at IBM, Bell Labs, GE, and GAIN. He cofounded GAIN and QED; the latter became the public company IQE and remains the world's largest compound-semiconductor epitaxial wafer supplier. He was a Consultant for the U.S. Air Force Research Laboratory, and a Program Officer for GHz-THz Electronics with the Air Force Office of Scientific Research. He was an IEEE Distinguished Microwave Lecturer. He is an IEEE Life Fellow and an Editor of IEEE Journal of Microwaves. He has worked for decades on electronic, optoelectronic, and micro-electromechanical materials, devices, and circuits. He was the recipient of many honors and awards, including the IEEE Lester F. Eastman Award for outstanding achievement in high-performance semiconductor devices. His current research focuses on sub-THz materials, devices, and circuits for next-generation automobile radars, Internet of Space, and 6G wireless communications.