

**A Complete Computer System on a Tiny Substrate for Ultra-Compact Edge Computing:** IBM researchers will detail a high-throughput, manufacturable, heterogeneous integration-based chiplet packaging process, for use in sensor data acquisition and secure communications in military, commercial and consumer applications. The process makes it possible to build a complete computer system with a wide range of functionality on a tiny substrate (<1mm2), comprising a 32-bit processor, memory, analog I/O with built-in temperature and chemical sensors, energy-harvesting power source, and operating system software. The process incorporates wafer-to-wafer (W2W) transfer, with integrated Si and/or III-V optical photovoltaic/photodiode cells fabricated on Si carriers.

To demonstrate the packaging process, the researchers built heterogeneous chips thinned to 50-100 μm, with lateral dimensions of several hundred microns, separated by ~20 μm gaps, and with 10-20 μm-diameter copper pillars. They say the process enables reliable and high-throughput system-on-a-carrier packaging with a diverse set of CMOS, GaN and GaAs chip technologies.

The images above show a backside emitting singulated GaN LED on sapphire flip-chip, bonded into the silicon smart chip platform, in both off (top) and on (bottom) states. The mechanically smooth, clean, laser-ablated singulated LED chip/sapphire edges eliminate optical loss through the LED sides.

**(Paper 34.6, “*Ultra-Compact Computing at the Edge Involving Unobtrusively Small Sub-millimeter Heterogeneous Integration Packaging*,” F. Libsch et al, IBM)**