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NEWS

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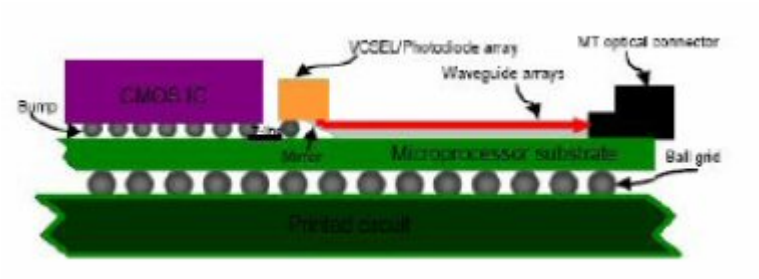
# Quantum dot VCSELs further chip comms

**High temperature operation lasers have brought 20 Gbit/s optical chip-to-chip data transfer closer, with similar technology being used elsewhere in co-operation with Intel.**

A German collaboration has increased the likelihood of replacing chip-to-chip electrical communication with optical data transmission, by making VCSELs that can operate at 120°C.

Researchers from Dieter Bimberg's group at Technical University, Berlin, produced the 20 Gbit/s, 980 nm InGaAs quantum-dot (QD) lasers described in the October 23 issue of *Electronics Letters*.

“Where VCSELs are used in chip-to-chip optical interconnects the operation temperature of the device should be adjusted to the CMOS chip temperature,” Bimberg told *compoundsemiconductor.net*. “Operation should be stable beyond 100 °C.”




Chip-to-chip interconnect

Bimberg's team designed and processed VCSELs based on MBE-grown epiwafers provided by its compatriot laser makers Innolume.

Although the VCSEL's bandwidth falls from 11 GHz at 120°C to 9.5 GHz at 150°C, Bimberg feels that its basic reliability is sufficient to stand the higher temperature.

“We do not see noticeable degradation at 150°C with high current densities, and this is a very good sign,” he said.

Quantum-well VCSELs have previously proven capable of maintaining high gain and bandwidths at 100°C, by suppressing the escape of non-equilibrium carriers at high temperatures. This approach has failed to deliver higher-temperature operation lasers

to date, however.

By choosing a deposition method that produces sub-monolayer (SML) size islands that behave as QDs, the 120°C VCSEL benefits from even higher carrier confinement.

“Vertically-correlated growth of SML QDs creates a significant potential depth to suppress in-plane mobility of non-equilibrium carriers,” Bimberg explained.

SML growth also provides a higher QD density than alternative methods, helping TU Berlin's VCSELs achieve higher gain.

TU Berlin is also working with QD epiwafers provided by German optoelectronic firm VI Systems on 850 nm SML VCSELs. They will report the first such devices to transmit data error-free at 20 Gbit/s at Photonics West in San Jose, California, held 24-29 January 2009.

Additionally, TU Berlin and VI Systems are currently working together with Intel's Irish operations on the €3.2 million ($4 million) European project named VISIT.



VISIT's aims include integrating electro-optic reflectance modulators with VCSELs for data transmission from the local area network scale down to inter-chip level communications. At the core of its many aims, VISIT seeks to raise bitrates further beyond 20 Gbit/s.

Other partners involved in the project, which started in June, include MBE equipment maker Riber, epiwafer manufacturer IQE and Russia's Ioffe Institute.

Much of the collaboration's quantum dot expertise comes from Bimberg and Nikolay Ledentsov, who worked at the Ioffe Institute and TU Berlin, before founding both Innolume and VI Systems. Ledentsov is now CEO of VI Systems, where Bimberg is

chairman of the scientific advisory board.