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Vertical-Cavity Surface-Emitting Lasers XVII

**Kent D. Choquette
James K. Guenter**
Editors

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Introduction:

It has been two decades since VCSEL papers began to appear at Photonics West and this is the seventeenth Proceedings of the conference dedicated to VCSELs. Many aspects of VCSELs have seen enormous progress. In these Proceedings you will find VCSELs with wavelengths ranging from the blue to two microns in the infrared, with effective apertures ranging from a few hundred nanometers to many tens of micrometers, and with optical powers ranging from less than 1 milliwatt to many watts. Additionally, you will discover VCSELs with data-communication modulation rates near 50 gigabits per second, VCSELs with wavelengths tunable over a range of a hundred nanometers or more, and VCSELs with a range of materials and structures incorporated into their construction so as to afford control of characteristics unthinkable two decades ago.

At the same time, as other papers in these Proceedings demonstrate, some of the details of VCSEL degradation mechanisms remain mysterious even as the reliability continues to improve.

While they had many obvious potential manufacturing advantages, the original VCSELs were all low power devices with limited applications. (Limited application types, rather, as total volumes in the data communication and laser mouse markets have reached many hundreds of millions of devices.) It seemed likely that applications requiring high power would perpetually be the realm of edge-emitting lasers. Over the last decade or so, as documented in previous editions of these proceedings, arrays of VCSELs have demonstrated very high optical power and, as they became available, it was found that some of their emission characteristics such as low coherence and circular symmetry made them more effective than any alternative in some applications.

Similar progressions of VCSEL-impossible, to possible, to product are in process today. One example uses widely tunable VCSELs fabricated with monolithic dome structures. This first appeared here only a few years ago. Originally aimed at gas sensing applications, they now have been found also to be nearly ideal light sources for optical coherence tomography (OCT), and are today available in commercial imaging products. OCT has become so important in medical and other imaging fields that there is an entire Photonics West BIOS conference dedicated to it with over a hundred papers this year, several dedicated to the significant advantages the tunable VCSEL brings.

What will cause VCSELs to shine next? Maybe it will be the control of polarization properties afforded by integration with liquid crystals as explored in more than one paper in this Proceedings. Otherwise, maybe red VCSELs will enter the high-power arena as another paper portends. Yogi Berra famously said something like, "It's tough to make predictions, especially about the future." This is as true of technology as of any other field. But it seems nevertheless that we can predict with confidence that the ways in which we can exploit VCSELs have not yet been exhausted, and we'll have interesting material for many VCSEL conferences yet to come.

James Guenter
Kent Choquette