HORIBA Scientific

MicOS characterizes Ge-based micro-LEDs

Room-temperature Micro-electroluminescent Characterization of Ge-based IR Sources

Monolithic integration of optical components on CMOS platforms is ongoing in the optical communications industry. CMOS offers a mature and robust platform, and therefore is logical for building optical-interconnect modules. These modules include light sources, modulators, multiplexers, and detectors on a single substrate. Silicon is the foundational material for CMOS technology, but as a material with an indirect bandgap, it poses a serious obstacle to building light sources via CMOS-based integrated photonics.

There is particular interest in integrated sources from 1300–1600 nm. Germanium has a bandgap exactly within this range. Like Si, Ge is a group IV element, so it is a likely candidate for integration on a CMOS device. Yet Ge is also an indirect-bandgap material but with an adjacent (higher-energy) well in the conduction band capable of direct transitions. Various mechanisms have been developed to engineer population of this direct-bandgap path in SiGe alloys leading to integrated light sources[1,2].

One class of such SiGe light sources uses an electrical bias to populate the direct bandgap path. Electroluminescence (EL) is an appealing method for characterizing such devices. Figs. 1 and 2 show the EL spectra of one such device (Fig. 3, left) measured using the HORIBA MicOS microscope spectrometer (Fig. 3, right).[3]

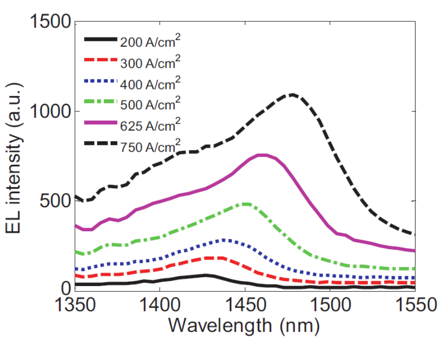

Fig. 1. Electroluminescence spectra of a Si-Ge quantum well as a function of (left) bias current, and (right) temperature.

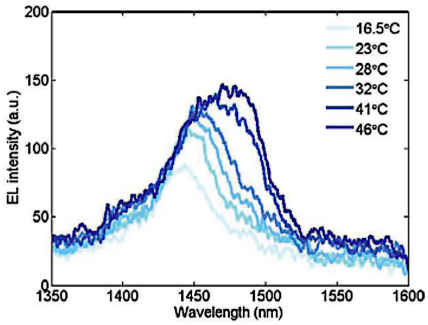

Fig. 2. Electroluminescence spectra of a Si-Ge quantum well as a function of temperature.

Fig. 3 (left). Representative image of EL from a micro-LED. (Right) Down-looking version of HORIBA MicOS with mapping stage.

References

1. S. Cho, *et al.*, *Optics Express*, **20**(14), 14921 (July 2012).
2. S. Chen, *et al.*, *Optics Express*, **17**(12), 10019 (June 2009).
3. E. Fei, *et al.*, *Proc. IEEE Conf. on Group IV Photonics* (2012), http://ieeexplore.ieee.org/xpl/abstractAuthors.jsp?reload=true&arnumber=6324112

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Specifications*

Spectrometers		iHR320		iHR550
Spectral range[1]		200 nm to 1600 nm		
Spectral resolution[2]		0.18 nm		0.1 nm
Detector	Type	CCD 1024 × 256 OE[3]	IGA 512 × 25	Single-channel
	Range	200–1050 nm	800–1600 nm	190–1600 nm[4]
Excitation laser[5]		532 nm	633 nm	785 nm
Microscope Objective	Magnification	10×	50×	100×
	Spot size	100 µm	<20 µm	<10 µm
Sample stage		*xyz* (manual or motorized)		

[1]Depends on choice of objective, filters, and detectors.
[2]For 1200 gr/mm grating and open-electrode CCD
[3]BIUV, BIVS, and BIDD formats available for specific quantum-efficiency requirements.
[4]Needs two detectors to cover entire range.
[5]Other options are available upon request.

*Specifications are subject to change without notice.

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