Quantum keys suit broadband networks

IEEE J. Quant. Electron. **43,** 130–138 (2007)

Concerns over the security of broadband-access networks may not be a headache for much longer, thanks to researchers in Scotland and Ireland. Veronica Fernandez and her co-workers from Heriot–Watt University in Edinburgh and the Tyndall National Institute in Cork have now demonstrated the feasibility of applying quantum key distribution (QKD) to multi-user passive optical networks (PONs) — the type of network used in fibre-to-the-home applications. The team has shown that their 850-nm-wavelength, gigahertz-clock-rate QKD system is compatible with common designs of PON and capable of transmitting over distances of up to 10 km at a clock frequency of up to 3 GHz.

The researchers report that performing QKD at a wavelength of 850 nm is advantageous because it is well isolated from the 1,300-nm and 1,500-nm windows used by conventional data channels.

Two types of PON were investigated — a point-to-multipoint system and a point-to-point system. The team claim excellent key-transmission performance in both cases with quantum-bit error rates of less than 10% and net key-bit rates of up to 147 kbit s^{-1}.

Silicon modulators get a speed boost

Opt. Express **15,** 623–628 (2007)

The development of high-performance silicon-based electro-absorption modulators is vital if the worlds of electronics and photonics are to be ultimately integrated on a single chip. With this aim in mind, researchers are continually striving to fabricate optical silicon modulators with a high responsivity and a wide bandwidth.

Jifeng Liu and his colleagues from Massachusetts Institute of Technology have taken another step towards this goal with the design of a fast GeSi electro-absorption modulator, monolithically integrated onto a silicon-on-insulator platform. By optimizing the dimensions of a modulator that is butt-coupled to a high-index-contrast $Si–SiO_2$ waveguide, the team predicts that a 3-dB bandwidth of >50 GHz and an extinction ratio of 10 dB could be obtained at 1,550 nm. Based on the same vertical structure but with a different width, a photodetector with a responsivity of about 1.1 A W^{-1} and a 3-dB bandwidth of >35 GHz is also envisaged.

The advantage of the design is that it can be fabricated with 180-nm CMOS technology and thus offers potential for monolithic on-chip integration.

Microcavity monitors chromatic dispersion

IEEE Photon. Tech. Lett. **19,** 21–23 (2007)

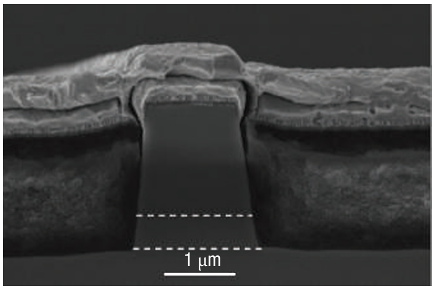
Chromatic dispersion in optical fibres — the variation in the speed of light with wavelength — has long been recognized as a phenomenon that degrades the performance of high-speed, long-distance optical communication. When dates rates exceed 40 Gbit s^{-1}, it is imperative to have *in situ* monitoring and compensation of chromatic dispersion, however this is hard to achieve for many simultaneous wavelength channels. Now it seems a nonlinear optical effect called two-photon absorption — the generation of a single electron–hole pair due to simultaneous absorption of two photons — could come to the rescue. European researchers report that a scheme based on two-photon absorption inside a semiconductor microcavity can monitor chromatic dispersion in a transmission link at signal data rates of up to 80 Gbit s^{-1} and is compatible with multiple channels. A collaboration between Irish and French researchers from Dublin City University, Trinity College Dublin and INSA in Rennes have demonstrated that such a system is capable of monitoring dispersion fluctuations at sensitivities of about 30 ps nm^{-1} at 40 Gbit s^{-1} and about 15 ps nm^{-1} at 80 Gbit s^{-1}. This is realized by observing the change in the two-photon-absorption photocurrent at the microcavity resonance. As the microcavity has a wavelength-dependent response, a single device can be used to monitor chromatic dispersion of multiple channels in a wavelength-division-multiplexed communication system.

Optical splitter beats polarization problems

IEEE J. Lightwave Technol. **24,** 5082–5086 (2006)

An all-solid photonic-crystal fibre with two cores is the key ingredient in a new type of a polarization-independent optical splitter proposed by a group of scientists from Jiangsu University, China. Ming-Yang Chen and Jun Zhou claim that their splitter offers a wide bandwidth (several tens of nanometres) and low crosstalk (–20 dB) and is suitable for use in wavelength-division-multiplexed communications systems. The proposed photonic-crystal-fibre splitter consists of a silica fibre containing a triangular lattice of low-index doped-silica rods, with two of the rods missing to form two high-index cores. Chen and Zhou calculate that for a fibre length of 10.69 mm, bandwidths as great as 25.4 nm and 42.2 nm around the wavelengths of 1,550 nm and 1,310 nm, respectively, can be achieved. The key to the design's success is the use of low-index silica rods instead of the air holes present in conventional photonic-crystal fibres. This important modification limits the index-contrast ratio to just a few per cent and dramatically reduces the difference in the coupling length between orthogonal polarizations as they travel down the fibre. The resulting design allegedly enables polarization-independent splitters with a polarization crosstalk as low as –20 dB at one wavelength. The simplicity in fabrication also paves the way to practical, monolithic devices that can be easily spliced into fibre networks.

Deep etching to ease integration



IEEE Photon. Technol. Lett. **18,** 2644–2646 (2006)

High-density integration of microphotonic devices such as quantum-dot lasers, photodetectors and passive waveguides may turn out to be easier than first thought. Researchers from Eindhoven University of Technology have shown that it is possible to fabricate InAs–InP Fabry–Pérot and ring-based quantum-dot lasers that feature narrow (1.65 μm wide), deeply etched waveguides and exhibit no penalties in operation at a wavelength of 1,550 nm. For example, a ring laser with a cavity length of 2 mm and corners with a radius of curvature of 100 μm had a typical threshold current of just over 100 mA, an output power of several milliwatts and a mode spacing of around 40 GHz. "The deeply etched lasers have the same threshold current densities as shallowly etched ones and do not deteriorate with time," report the researchers. "These observations show that more compact integrated photonic devices can be realized through the use of deeply etched bends with a small radius of curvature."