demonstrated by Leuthold and colleagues[1] could also significantly reduce the number of lasers required. Furthermore, the use of wavelength-selective multiplexers makes this technique far more power-efficient than standard serial schemes. For serial signals, the multiplexers are based on power couplers and are therefore inherently lossy. Thus, even though a serial optical transmitter may be more efficient than a traditional parallel wavelength-division multiplexed transmitter, the parallel single-source OFDM transmitter demonstrated by Leuthold and co-workers seems to be even more energy-efficient.

Of course, the overall power consumption of a communication system is not given merely by the transmitter; we must also consider the receiver structure, repeater spacing, regeneration technology, switching scheme, associated electronic devices and network design. The receiver suggested by Leuthold and co-workers has a passive fast Fourier transform mechanism and an active EAM gate. As mentioned previously, an EAM requires only a relatively low driving voltage, so this is a good choice. However, each OFDM channel requires its own EAM, meaning that 325 EAMs must be housed in the receiver. It would be desirable to reduce the number of gates or at least reduce the power consumption of the gates. This issue has been addressed through the demonstration of switching at energies as low as 50 fJ bit^{-1} in EAM-type gates made in germanium-on-silicon quantum well structures[10]. Other gate types are also being researched, which will certainly give more options for improving the power budget of this system.

The work of Leuthold and colleagues[1] does not take full advantage of the entire bandwidth of each OFDM channel because of limitations in, for example, the available modulators. 20–28% of the bandwidth is unused to avoid overlapping between neighbouring channels. This will most likely be overcome in future systems, thereby providing an extra capacity of 20–28%. In addition, the work of Leuthold and colleagues has an error-correction overhead of 25%, which essentially means that one in every four bits is not used to carry real information. Using more efficient error-correcting code would further increase the available capacity.

This benchmark experiment demonstrates the potential of single-source OFDM data transmission, and is certain to encourage discussions about how to optimally achieve high-capacity, energy-efficient data transmission in the future. ❐

Leif Katsuo Oxenløwe is in the Department of Photonics Engineering, Technical University of Denmark, Kgs. Lyngby, DK-2800, Denmark.
e-mail: lkox@fotonik.dtu.dk

References

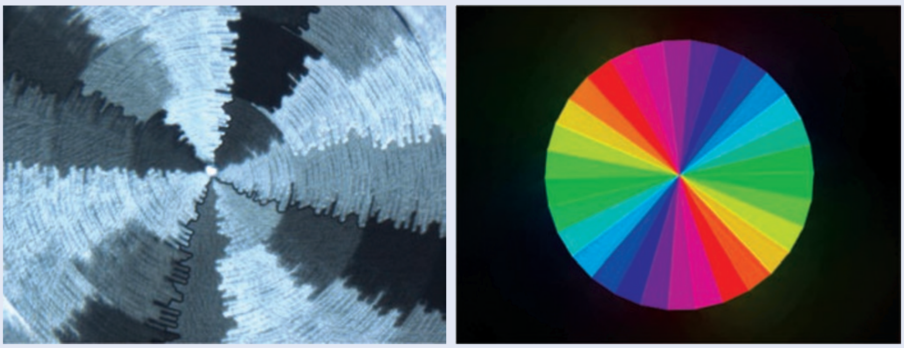
1. Hillerkuss, D. *et al. Nature Photon.* **5,** 364–371 (2011).
2. Ma, Y., Yang, Q., Tang, Y., Chen, S. & Shieh, W. *Proc. Optical Fiber Communications Conf.* post-deadline paper PDPC1 (2009).
3. Dischler, R. & Buchali, F. *Proc. Optical Fiber Communications Conf.* post-deadline paper PDPC2 (2009).
4. Nakazawa, M., Yamamoto, T. & Tamura, K. R. *Electron. Lett.* **36,** 2027–2029 (2000).
5. Hu, H. *et al. Proc. Eur. Conf. Optical Communication* paper P4.18 (2010)
6. Richter, T. *et al. Proc. Optical Fiber Communication Conf.* post-deadline paper PDPA9 (2011).
7. Yu, J., Dong, Z. & Chi, N. *Proc. Optical Fiber Communication Conf.* post-deadline paper PDPA6 (2011).
8. Qian, D. *et al. Proc. Optical Fiber Communication Conf.* post-deadline paper PDPB5 (2011).
9. Miller, D. A. B. *Proc. IEEE* **97,** 1166–1185 (2009).
10. Liu, J. *et al. Nature Photon.* **2,** 433–437 (2008).

POLARIZATION

Making vortices of light

Optical beams with radial or azimuthal polarization are of interest for applications such as particle acceleration and imaging beyond the diffraction limit, but generating such beams is not a trivial matter. Martynas Beresna and co-workers from Southampton University and the Lithuanian firm Altechna have now fabricated a monolithic glass polarization converter that promises to greatly simplify this task (*Appl. Phys. Lett.* in the press; 2011). The team's optical vortex converter is capable of transforming the polarization of an input beam from circular to either radial or azimuthal, depending on whether the input beam is left- or right-handed.

Previous studies have demonstrated that illuminating a silica glass substrate with femtosecond pulses can generate self-assembling nanostructures that exhibit birefringence. The researchers calculated that a silica substrate covered with a spiral pattern of such nanostructures could be used to convert circularly polarized light into either radially or azimuthally polarized light.



UNIVERSITY OF SOUTHAMPTON

They tested their prediction by focusing a train of intense pulses from an amplified femtosecond Yb:KGW laser system (pulse length of 270 fs, wavelength of 1,030 nm and optimal repetition rate of 200 kHz) onto a 2-mm-thick fused silica sample mounted on a computer-controlled translation stage. They moved the sample in 1 μm steps during exposure to produce the required spiral pattern. The resulting design of nanostructures provided a retardance as large as 260 nm, which is sufficient for performing the required polarization conversion at visible and near-infrared wavelengths. The researchers say it takes around 1.5 hours to produce a 1.2-mm-diameter converter. They characterized the converters using a quantitative birefringence measurement system; the images above show the spiral pattern of the glass nanostructures (left) and the resulting spatial variation in retardance (right).

OLIVER GRAYDON