the fcc sample. The polarized transmittance of a 6 μm thick 2D square lattice sample is shown in Fig. 3(a), which implies the confined LC is highly aligned along the substrate. The Bragg reflection corresponds to (1 1) planes. The TM reflectance of a 12 μm thick sample as a function of applied electric field is shown in Fig. 3(b). Figure 3(c) shows the transmittance of fcc samples. Two prominent stopbands appear in the visible transmission spectrum at normal incidence, arising from the (0 0 1) and (1 1 1) lattice planes. The relatively small depth of these stopbands can be attributed to the limitation of index mismatch and incomplete phase separation during holographic fabrication. For normal incidence, these stopbands were extinguished. However, when light was incident at −19° from the substrate normal (cos2θ=0.210 0.981), a 10 nm wavelength shift of the stopband arising from the (1 1 1) lattice planes was observed. The electro-optic response of this situation is plotted in Fig. 3(d).

4. Summary

We successfully utilized a holographic method to fabricate tunable 2D transverse and fcc lattices in LC/polymer systems. 2D square lattice PdlCs shows strong polarization dependence. The stopband of fcc samples can achieve reversible 2% wavelength shift when an electric field is applied. References

Hence, all we need is to evaluate the time-averages in (2).

Now, suppose a string of k consecutive '1' occurs in the pump bit sequence. To evaluate the effect of such a string on $\Delta (t)$, we assume to modulate the pump with a periodic sequence of k '1' followed by k '0' and so on. A periodic and slow-symmetric signal $\Delta (t)$ results with period 2kT, being T the bit period. We can easily evaluate the angle $\Delta (t)$ from (1) if we approximate $\Delta (t)$ with the first harmonic of its Fourier series expansion: $\Delta (t)$ is a periodic function $\frac{1}{2\pi}$ sin($\omega_0 t$), where $\omega_0$ is the frequency of the 101... bit sequence. Note that the integral in (1) is the convolution of the normalized pump with a wall-off filter H(\omega), whose amplitude response can be approximated as $H(\omega)$ for long fibers ($\omega \rightarrow 0$) [5]. Hence, one gets $\Delta (t) = \frac{1}{2\pi} \int H(\omega) \sin(\omega_0 t) \, d\omega$. To evaluate the time-averages in (2), we can expand $\cos(\Delta (t))$ and $\sin(\Delta (t))$ in Fourier series. Averaging over periods much longer than kT, one gets $\langle \cos(\Delta (t))\rangle = 0$, and $\langle \sin(\Delta (t))\rangle = 0$, where $\langle \rangle$ is the time average, and $\Delta (t)$ is the phase difference between the first and kth order Bessel functions of the first kind, and $\Delta (t)$ is the maximum swing angle for the probe SOP. Of course, when the pump is modulated by a pseudo-random bit sequence (PRBS), we should consider all possible strings of k ones ($k=1...8$). In an unseeded PRBS, the relative occurrence of such strings is $1/2^k$. Regarding to the ergodicity of the process $\Delta (t)$, we can evaluate the time-average $\langle \cos(\Delta (t))\rangle$ through the summation of $\Delta (t)$ terms weighted by their relative occurrence. Propagation on more than one span can be easily accounted for by multiplying the arguments of the $I_n$ functions by $N_{op}$, provided that fiber losses are recovered and data dispersion is perfectly compensated at each span.

The final formula for the DOP is:

$$DOP = \left[ \frac{1 - \cos^2(\theta) - \cos(\theta) \cos(\phi)}{1 + \cos^2(\theta) - \cos(\theta) \cos(\phi)} \right]$$

which is an approximation, since we are only approximating an actual PRBS. The dependence of the DOP on the relative pump-probe polarization angle $\phi$ can be made explicit by using the two relations given above for $\theta$ and $P_0$. From (3), we see that, if polarization control of the signals ($\phi=\pm 90^\circ$) is not achievable, e.g. due to PMD, the basic countermeasure against DOP degradation is to increase $P_{op}$ by further spacing the channels or by using a more dispersive fiber. Increasing the bit rate implies both a smaller $T$ and a larger $\Delta_{op}$, in (3), hence a reduction of XPM-induced DOP degradation. Experimental and simulations results: We performed DOP measurements on the dispersion-managed 3x100 km link depicted in Fig. 1. The dispersion map is shown in the inset. We used a light source as the transmission fiber, with $\alpha=0.2$ $\text{dB} / \text{km}$, $\gamma=1.8$ $\text{W}^{-1} \text{km}^{-1}$ and $D=8$ $\text{ps} / \text{nm} / \text{km}$, whose total measured DGD on the link is below 2 ps, so that PMD can be safely neglected. Pump and probe are spaced by $\Delta_{op}=8$ nm and are NRZ modulated at 10 Gb/s by independent bit sequences.

We performed five sets of 500 measurements of both the input pump DOP and the output DOP, after filtering the probe channel, randomly changing the polarization controller (PC) each time. Fig. 2a-e reports the measured probe DOP (dots) versus $\phi$, along with simulation results (triangles), and the theoretical DOP curve (solid line). The average probe power is fixed at 3 $\text{dBm}$ ($P_{op}=6$ $\text{dBm}$) while the ratio $P_{op}$ is varied for each set of measurements. The relative polarization angle $\phi$ is easily calculated from the measured input DOP and the ratio $P_{op}$. Fig. 2f reports BER measurements for the same case of Fig. 2e. Without giving details about the receiver, the purpose of this figure is to show that, as $\phi$ increases, the efficiency of XPM is reduced by the misalignment of pump and probe polarizations and, as is well known, the best performance is obtained for orthogonal polarization (in Jones space) channels (8-180°). All plots in Fig. 2a-e have the same V-shape. Their symmetry, however, is related to our system parameters and is not a general feature of (3). In fact, by increasing $P_{op}$, a shift of the minimum towards larger $\theta$ values is observed from (3). We use different DOP scales to highlight the cases in which the pump power is smaller. The spread in the measurement points is mainly due to the amplifier noise, which is the main source of degradation when XPM is negligible (small $\theta$).

The purpose of this paper is to experimentally check the reduction of PMD mitigation efficiency from a statistical point of view. 2. Considerations about XPM Impact on PMD compensation

In this paper we focus on first-order compensation. It consists of a polarization controller and a piece of Polarization Maintaining Fiber (PMF) (see OPMDC on Fig. 3) and it aims at inverting PMD conditions that the incoming...