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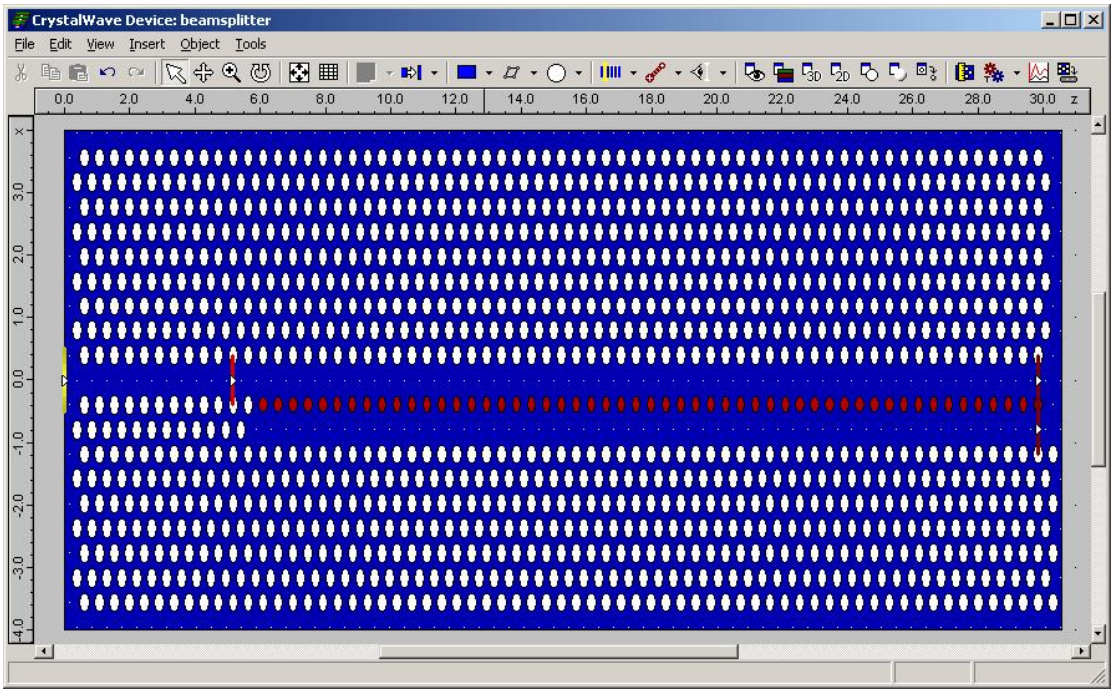
Modelling of Polarizing Beam Splitter

Overview

CrystalWave has been used to set up a polarizing beam splitter based on the information given in reference 1. The device has has been used to demonstrate that the CrystalWave FDTD engine gives comparable results for both TE and TM polarisation.

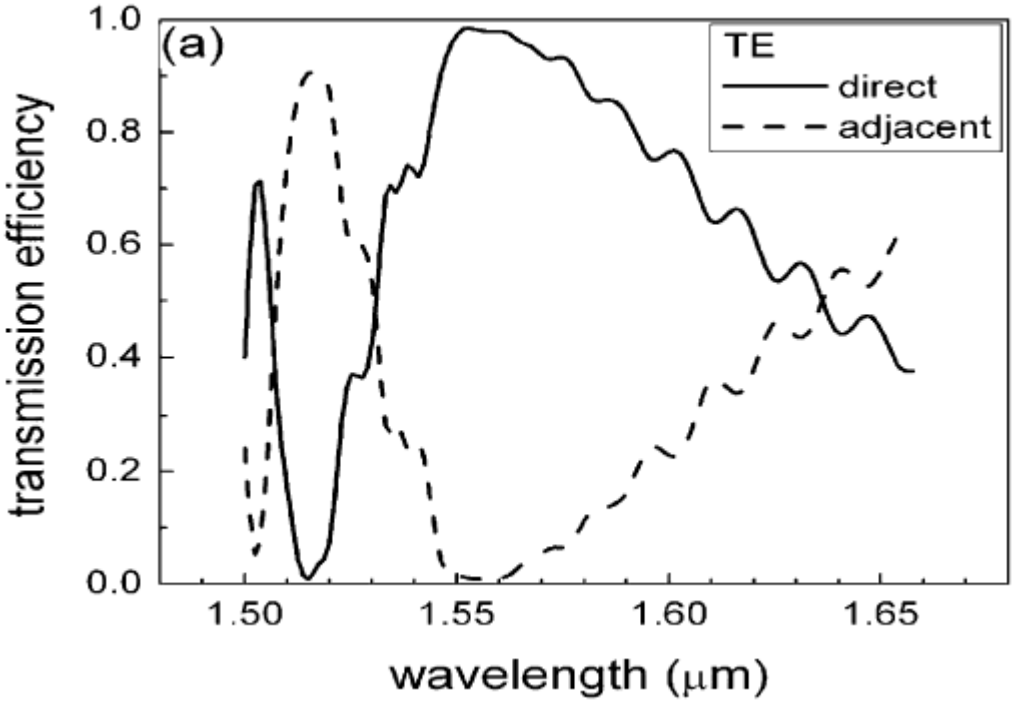
Results

The device in reference 1 is shown schematically in figure 1.



The blue region has a refractive index of 3.32, whilst the white and red holes have a refractive index of 1 ie air holes. The lattice spacing is set to 0.457 um and the diameter of the white holes is 0.294 um, whilst the red holes have a diameter of 0.236 um. The coupling region has a length of 53 lattice units and the input waveguide is 11 units long. Light is launched into the device via a gaussian excitor (yellow line) centred at 1.55 um. The bright red line is an input sensor and two more sensors are positioned at the output of the coupler.

The paper in reference 1 does not give details of the FDTD simulation parameters. For the CrystalWave simulations a grid size of 0.03 um was used and the propagation was for 24,000 time steps. The Fourier transform was taken over 65536 time steps. The simulation takes about 10 minutes on a 2GHz PC. The simulation was performed twice, once with TE launch and once with TM launch. The results are shown below in figures 2 and 3, together with the data from reference1. As can be seen there is good agreement.


(a)
TE
direct
adjacent
transmission efficiency
wavelength (μm)
1.0
0.8
0.6
0.4
0.2
0.0
1.50
1.55
1.60
1.65

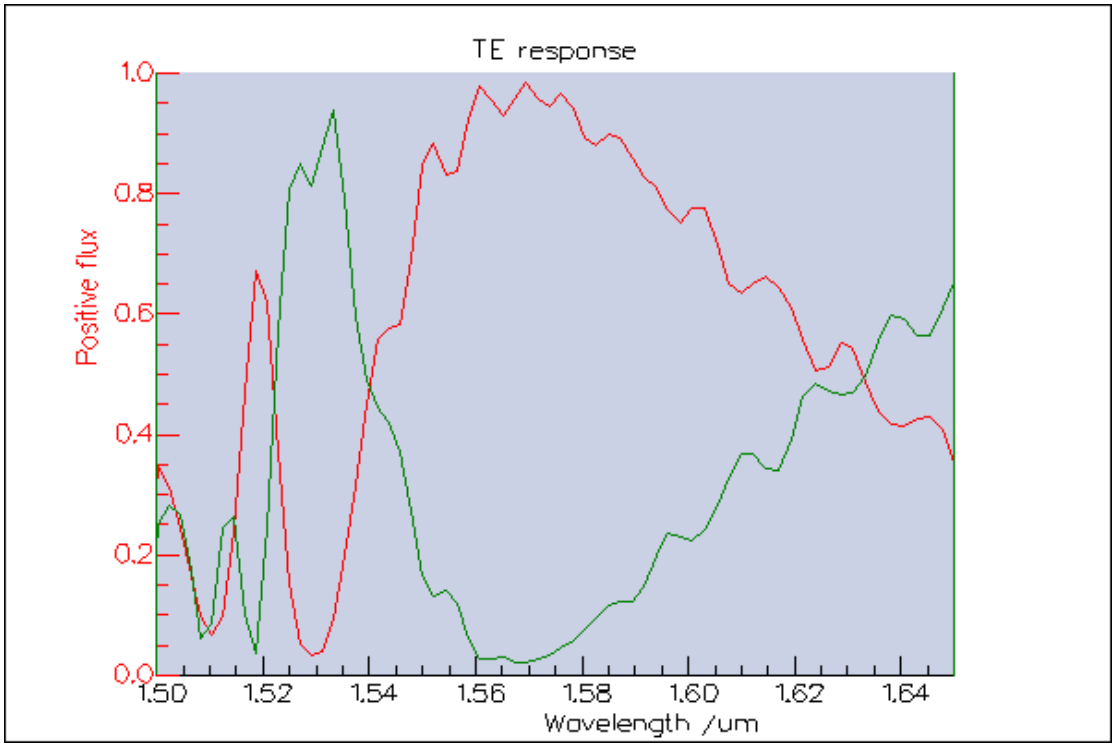
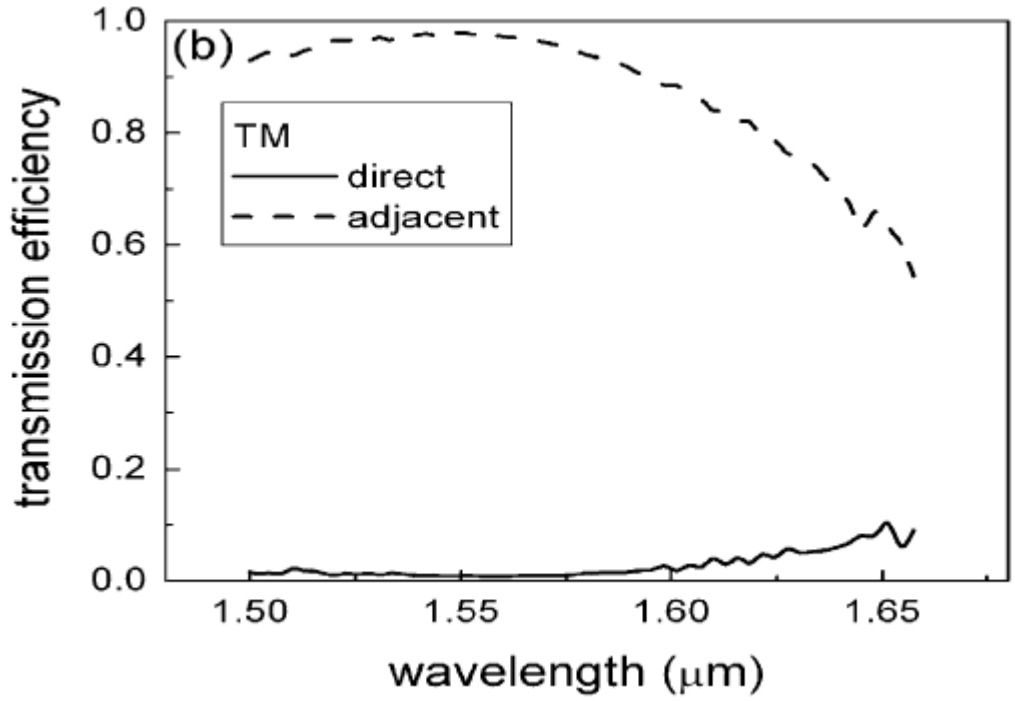

TE response
Positive flux
Wavelength /um
1.0
0.8
0.6
0.4
0.2
0.0
1.50
1.52
1.54
1.56
1.58
1.60
1.62
1.64

Figure 2: Response for TE polarisation



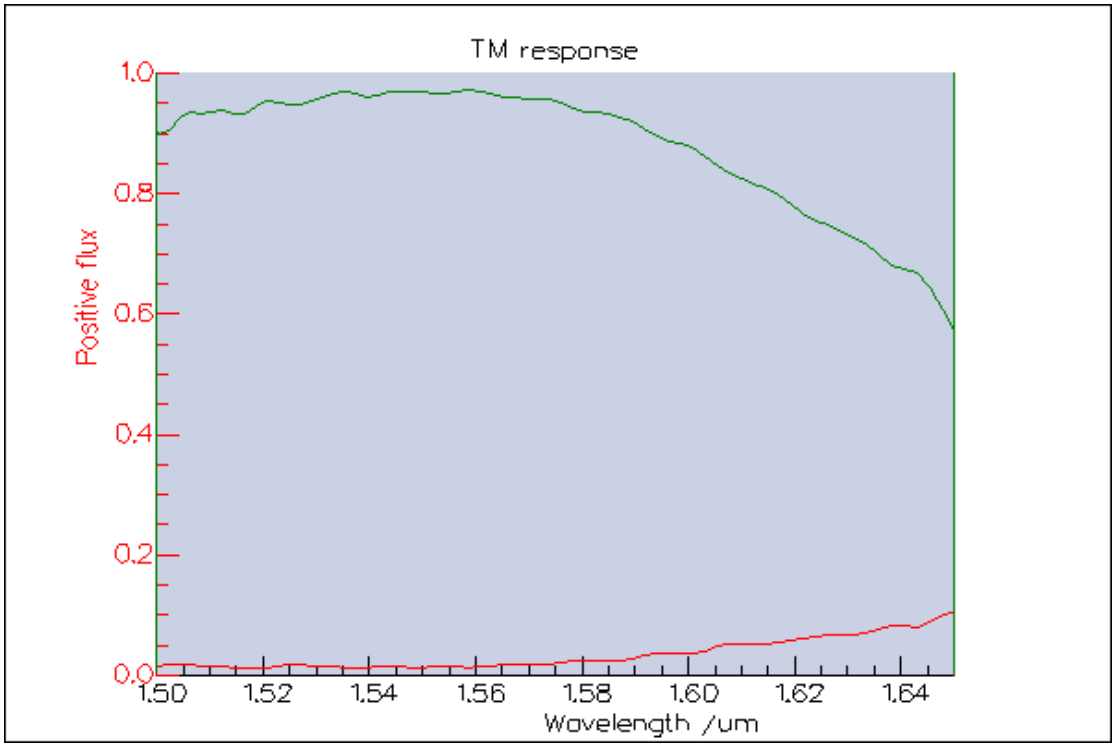


Figure 3: Response for TM polarisation

References

1) Design of a compact photonic-crystal-based polarizing beam splitter ; Photonics Technology Letters, IEEE, Vol. 17, No. 7. (2005), pp. 1435-1437.