Optical Wavelength Narrow Bandpass Filter

1) Introduction

The proposed device is a narrow bandpass filter that operates in transmission mode. The device utilizes the dispersion effects of two fibre Bragg gratings (FBG) in the coupling region of a twin core optical fibre to achieve highly selective coupling and produce bandwidths of <0.05nm, suitable for DWDM networks applications.

2) Setup

The disadvantage of using FBG’s in a transmission mode filter is that they will introduce some reflection loss to the signal. It was found that the smaller the bandwidth, the more reflection loss that occurred.

3) Principles of Operation

Coupling

A complete transfer of signal power between two cores is possible if their propagation constants ($\beta$) are equal at the signals wavelength. Coupling can also occur to a lesser extent at wavelengths where the difference in $\beta$’s is small.

One way to reduce the coupling bandwidth, is to reduce the range in which the $\beta$’s are similar.

Effects of the FBG’s

Adding a FBG to a core changes its propagation constant around the Bragg wavelength by increasing the effective refractive index.

This property is used to increase the cross over angle of the propagation constants and hence reduce the coupling (and output) bandwidth.

4) Results

<table>
<thead>
<tr>
<th>$\lambda_{in}$ (nm)</th>
<th>$\lambda_{out}$ (nm)</th>
<th>3dB Bandwidth (pm)</th>
<th>Reflection Loss (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1551</td>
<td>1555</td>
<td>1</td>
<td>0.72</td>
</tr>
<tr>
<td>1550</td>
<td>1556</td>
<td>2.8</td>
<td>0.31</td>
</tr>
<tr>
<td>1549</td>
<td>1557</td>
<td>5.6</td>
<td>0.17</td>
</tr>
<tr>
<td>1548</td>
<td>1558</td>
<td>9.2</td>
<td>0.11</td>
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<tr>
<td>1547</td>
<td>1559</td>
<td>13.8</td>
<td>0.08</td>
</tr>
<tr>
<td>1546</td>
<td>1560</td>
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<tr>
<td>1545</td>
<td>1561</td>
<td>25.4</td>
<td>0.05</td>
</tr>
<tr>
<td>1544</td>
<td>1562</td>
<td>32.4</td>
<td>0.04</td>
</tr>
</tbody>
</table>

A similar device using only one FBG achieved a bandwidth of 560pm. (Peng and Ankiewicz, Elec. Lett. Vol.33 No.25, 4/12/97)

5) Conclusion

The results achieved are a dramatic improvement on many existing narrow bandpass filters. The bandwidths achieved would make this device useful in DWDM networks and the reflection losses are not considered too inhibitive of the devices performance.