Phase-modulated PPKTP grating descriptions (9/29/2023)

L=30mm, dual-process SPDC of y->yz and y->zy. We focus here on the downconversion of

775 nm → 1531 nm + 1569.5 nm (or approximate wavelengths).

First three gratings based on grating #2 from Sesha Challa (Pavan)’s calculation, which was

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PMOD | T(°C) | Λ0 (μm) | N = ΛPM/Λ0 | Sig (nm) | Idler (nm) | phifunc |
| Lamp=775.23  Lam1=1550.5088 | 43 | 46.150 | 30 | 1531.13 | 1570.29 | [0.000 0.38 0.5 0.85 0.3872 0.88024 0.0000] |

I added data on CTE (dadT=6.7e-6 1/K, d2adT2=11e-9 1/K^2), which only changes the operating temperature a little bit from 43°C to 41.7°C.

Example tuning spectra (equal peaks)



The modified structures have different phifunc (with all other parameters mentioned above). I ran the code twice: first with freely varying domain boundaries and then by forcing each domain boundary to be on a 0.025 μm grid (at T=25°C). This caused no change in the wavelengths, but slight change in the peak ratio.

Design #2a – equal peak heights

phipoints = [0.000 0.38 0.5 0.85 0.3872 0.88024 0.0000];

|  |  |
| --- | --- |
| No grid-snap | With grid-snap |
| Peak= 1531.128 1531.128  FWHM= 0.781 0.774 nm  Peaks= 0.4078 0.4078  Peak ratio = 1.0002  Max width= 46.1500  Min width= 5.2057 | Peak= 1531.128 1531.128  FWHM= 0.781 0.774 nm  Peaks= 0.4077 0.4079  Peak ratio = 0.9997  Max width= 46.1750  Min width= 5.2250 |

Design #2b – first peak is slightly smaller (~5%)

(first peak represents y->yz, second is y->zy)

phipoints = [0.000 0.38 0.5 0.83838 0.32 0.86 0.0000];

|  |  |
| --- | --- |
| No grid-snap | With grid-snap |
| Peak= 1531.128 1531.128  FWHM= 0.780 0.774 nm  Peaks= 0.3946 0.4151  Peak ratio = 0.9505  Max width= 46.1500  Min width= 8.3070 | Peak= 1531.128 1531.128  FWHM= 0.780 0.774 nm  Peaks= 0.3945 0.4152  Peak ratio = 0.9502  Max width= 46.1750  Min width= 8.3000 |

Design #2c – first peak is slightly larger (~7.6%)

(first peak represents y->yz, second is y->zy)

phipoints = [0.000 0.38 0.5 0.81 0.402 0.84 0.0000];

|  |  |
| --- | --- |
| No grid-snap | With grid-snap |
| Peak= 1531.128 1531.128  FWHM= 0.781 0.773 nm  Peaks= 0.4130 0.3838  Peak ratio = 1.0763  Max width= 46.1500  Min width= 4.5227 | Peak= 1531.128 1531.128  FWHM= 0.781 0.773 nm  Peaks= 0.4130 0.3838  Peak ratio = 1.0761  Max width= 46.1750  Min width= 4.5000 |

Two gratings based on grating #5 from Sesha Challa (Pavan)’s calculation, which was

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PMOD | T(°C) | Λ0 (μm) | N = ΛPM/Λ0 | Sig (nm) | Idler (nm) | phifunc |
| Lamp=774.88  Lam1=1549.8057 | 49 | 46.125 | 31 | 1531.07 | 1568.92 | [0.000 0.38 0.5 0.85 0.392 0.88024 0.0000] |

Corrected temperature with CTE = 47.5 °C

Design #5a – equal peak heights

phipoints = [0.000 0.38 0.5 0.85 0.392 0.88024 0.0000];

|  |  |
| --- | --- |
| No grid-snap | With grid-snap |
| Peak= 1531.068 1531.068  FWHM= 0.785 0.776 nm  Peaks= 0.4044 0.4044  Peak ratio = 1.0001  Max width= 46.1250  Min width= 4.9815 | Peak= 1531.068 1531.068  FWHM= 0.785 0.776 nm  Peaks= 0.4044 0.4044  Peak ratio = 0.9999  Max width= 46.1250  Min width= 5.0000 |

Design #5b – first peak is slightly higher (~7%)

phipoints = [0.000 0.38 0.5 0.805 0.4 0.825 0.0000];

|  |  |
| --- | --- |
| No grid-snap | With grid-snap |
| Peak= 1531.060 1531.060  FWHM= 0.785 0.777 nm  Peaks= 0.4006 0.3743  Peak ratio = 1.0703  Max width= 46.1250  Min width= 4.6125 | Peak= 1531.060 1531.060  FWHM= 0.785 0.777 nm  Peaks= 0.4006 0.3743  Peak ratio = 1.0701  Max width= 46.1250  Min width= 4.6250 |

Last design based on grating #6 from Sesha Challa (Pavan)’s calculation, which was

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| PMOD | T(°C) | Λ0 (μm) | N = ΛPM/Λ0 | Sig (nm) | Idler (nm) | phifunc |
| Lamp=772.46  Lam1=1544.9457 | 49.4 | 46.150 | 42 | 1531.18 | 1558.91 | [0.000 0.38 0.5 0.85 0.4289 0.88024 0.0000] |

Temperature with CTE = 48°C

Design #6a – equal peak heights

phipoints = [0.000 0.38 0.5 0.85 0.3872 0.88024 0.0000];

|  |  |
| --- | --- |
| No grid-snap | With grid-snap |
| Peak= 1531.173 1531.173  FWHM= 0.783 0.776 nm  Peaks= 0.4037 0.4036  Peak ratio = 1.0003  Max width= 46.8423  Min width= 4.5688 | Peak= 1531.173 1531.173  FWHM= 0.783 0.776 nm  Peaks= 0.4037 0.4036  Peak ratio = 1.0003  Max width= 46.8500  Min width= 4.5500 |

Example spectrum (smaller sig-idl detuning)

