# Sinc-Sampled Fibre Bragg Grating for Identical Multiwavelength Operation

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*Abstract*

Through a periodic sinc modulation of the refractive index-profile in a 10 cm fibre Bragg grating we demonstrate 4, 8, and 16 equally spaced wavelength channel filters with identical 100 GHz passbands.

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Fibre Bragg grating devices are finding many applications in optical communications networks. Of particular interest is the correction of chromatic dispersion in existing fibre links offered by chirped fibre Bragg gratings [1]. In order to utilise the full bandwidth potential of fibre networks and cope with the increasing flow of information different schemes have been demonstrated based on either time division multiplexing (TDM) or wavelength division multiplexing (WDM); and the international standard (ITU-standard) for channel separation in a WDM scheme has been set to 100 GHz.

A powerful approach to the WDM solution is the use of sampled fibre Bragg gratings as multichannel dispersion compensators. A sampled grating is generated by a periodic modulation of the refractive index amplitude and phase in the fibre [2-4]. The resultant reflection spectrum and channel separation is a function of the period and shape of this modulation. Previously reported sampled fibre Bragg gratings have utilised simple binary sampling functions with regions of 'dead-space' that create channels of un-equal strength and bandwidth. The gratings that we demonstrate, in contrast, are composed of a sinc-shaped sampling function that causes the overall envelope to be square. Furthermore the individual sections are concatenated thereby ensuring continuously alternating refractive index amplitude and phase profiles so no potential coupling is lost from the sampling process of the grating. The sinc-shape of the refractive index modulation is generated using apodisation along the length of the grating.

Fig. 1 shows the complex refractive index profile and the regions of phase shift in the gratings whilst Fig. 2 a)-c) show examples of sampled gratings with Bragg wavelengths of 1560.5 nm comprising 4, 8 and 16 wavelength channels respectively, all with *complete* out-of-band wavelength suppression. Each sampled grating is 10 cm long and written in Deuterium loaded germanosilicate fibre using a recently developed continuous grating writing technique [5]. The UV-source used to write the gratings is an intra-cavity frequency doubled Argon-ion laser producing 100 mW of 244 nm light. The time taken to write the sampled grating with 16 identical channels was just 15 min and the requisite refractive index change for such a structure is $\sim 10^{-4}$. All channels exhibit identical characteristics, being uniform with a 16 pm bandwidth and ~10 dB of transmission loss. The channel separation is 100 GHz giving a finesse of 50.

These devices simplify the manufacturing of multiple matched gratings where very accurate wavelength separations are required. Packaging and temperature stabilisation demands are also reduced because these gratings (e.g 16 wavelength channels with the characteristics of 16, 10 cm gratings) all are contained within the same 10 cm length of fibre. Furthermore by chirping the Bragg wavelength they can offer practical, multichannel WDM dispersion compensation exhibiting finite and controllable numbers of wavelength channels with a spectral response devoid of out-of-band features. Further results will be given at the conference.

In conclusion we demonstrate WDM sampled fibre Bragg gratings with identical characteristics in all wavelength channels and complete suppression of out-of-band spectral features. The gratings are generated through a controlled sinc-shaped modulation of the refractive index amplitude and phase profile in the fibre. Examples of 4, 8 and 16 channel gratings with channel separations of 100 GHz are shown.

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## *Figure captions*

Fig. 1 Refractive index and phase profile of equal strength sampled fibre gratings.

Fig. 2 a) Reflection characteristics of a 10 cm long 4 channel sampled fibre Bragg grating with a channel separation of 100 GHz.

b) Reflection characteristics of a 10 cm long 8 channel sampled fibre Bragg grating with a channel separation of 100 GHz.

c) Reflection characteristics of a 10 cm long 16 channel sampled fibre Bragg grating with a channel separation of 100 Ghz..

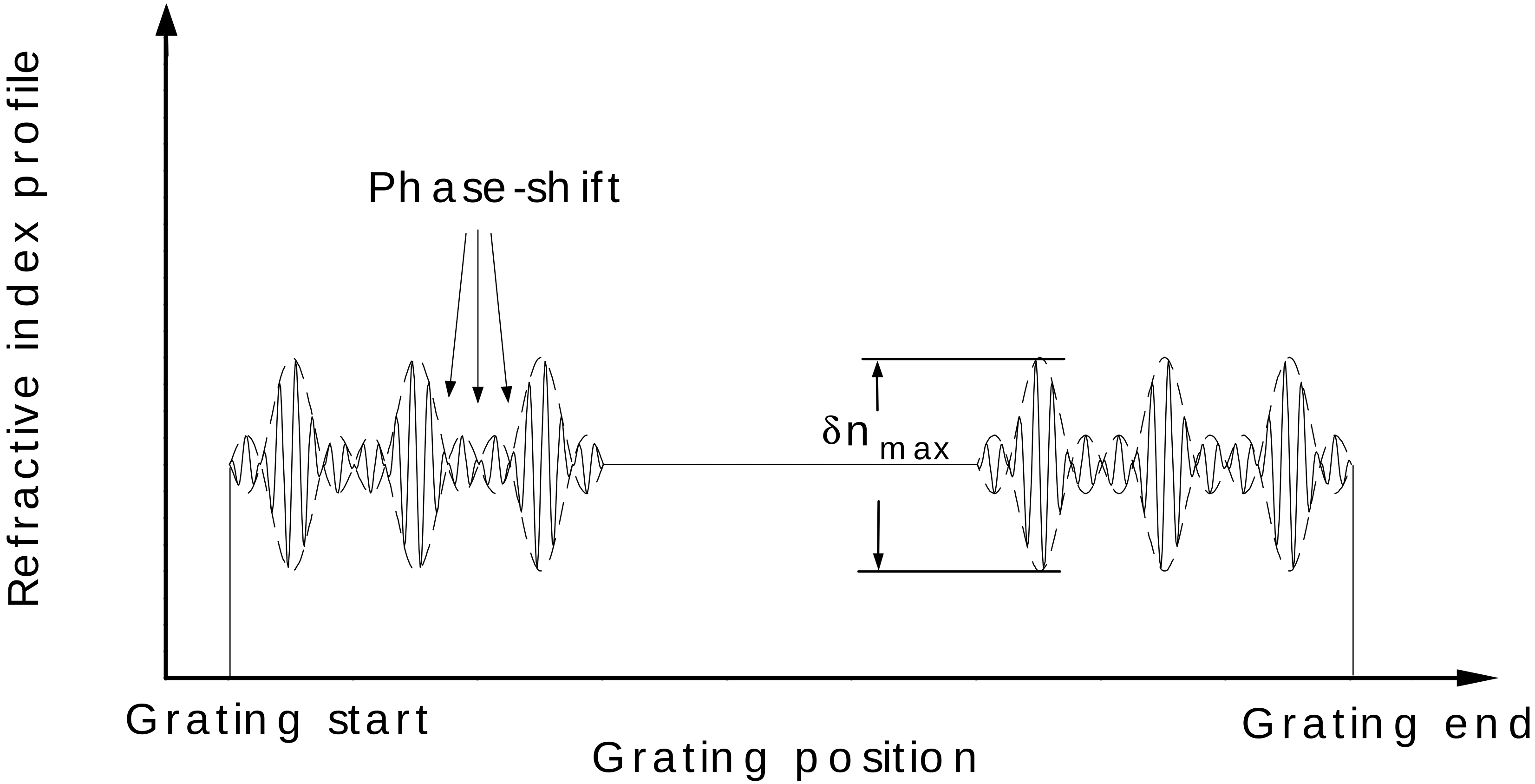
Refractive index profile
Phase-shift
$\delta n_{max}$
Grating start
Grating end
Grating position

Fig.1

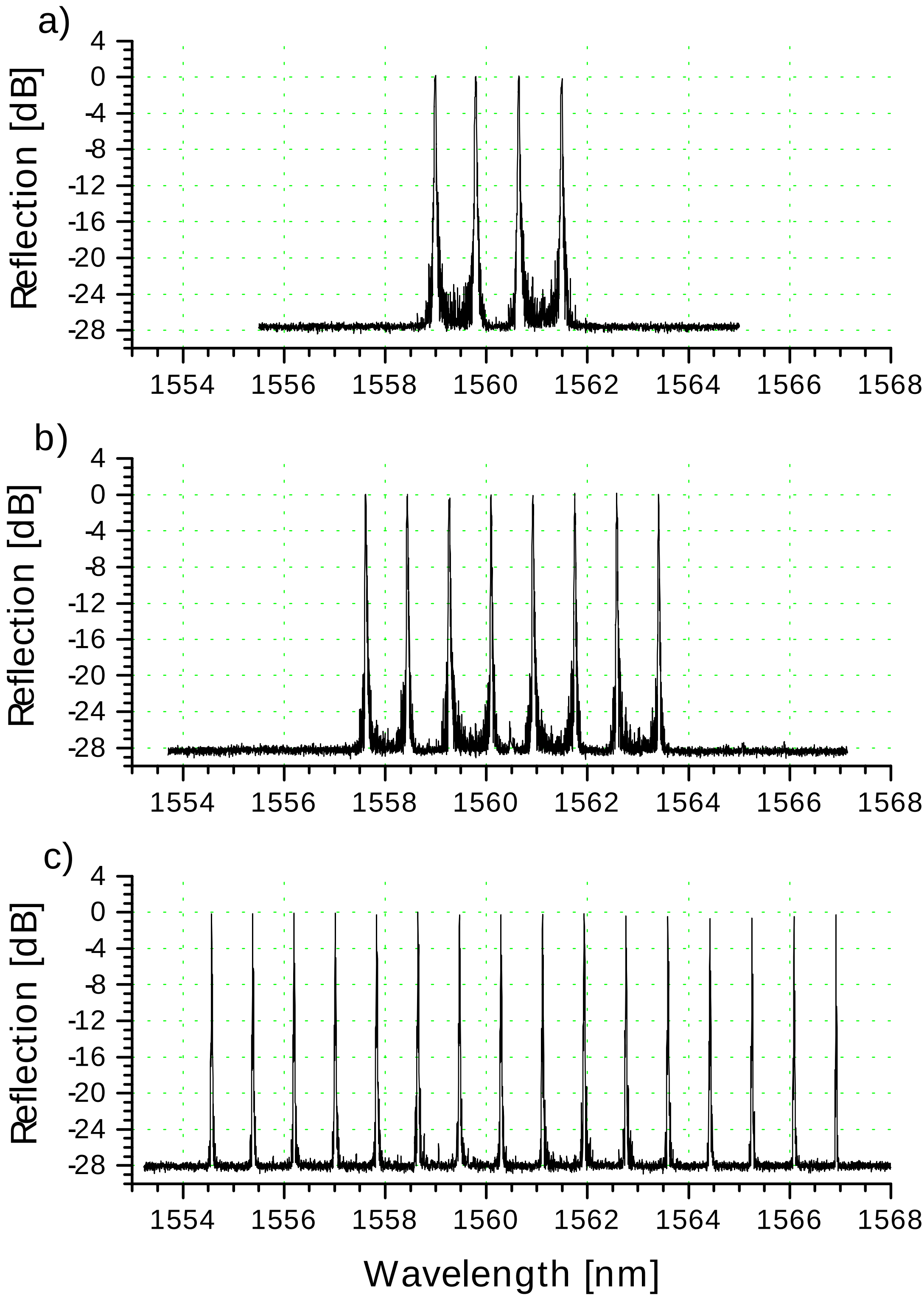
a)
b)
c)
Reflection [dB]
4
0
-4
-8
-12
-16
-20
-24
-28
1554
1556
1558
1560
1562
1564
1566
1568
Wavelength [nm]

Fig. 2.