# Silicon Photonic Bragg-Grating add-drop filters and multiplexers using UV lithograpy

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**Abstract:** Next generation short reach communication systems require high-performance and low cost optical filters for wavelength division multiplexing. We measured performance of add-drop filters fabricated using a CMOS compatible process. C-band and O-band.

## 1. Introduction

### 1.1. *Relevance and place in the greater scheme*

Point out that optical filters are needed for WDM.

### 1.2. *State of the Art*

Speak about lattice filters, echelle/arrayed waveguides, ring on SOI. None of these are flat top, limited FSR, low bandwidth. Bragg gratings only reflect. Apodized contra-DC only work on E-beam. [?]

### 1.3. *Challenges*

Small corrugation size and period, expecially at 1310. Accuracy for apodization. Large enough coupling

## 2. Device

### 2.1. *Design*

Slab and thin waveguides for bigger overlap. Traditional apodized side-wall grating.

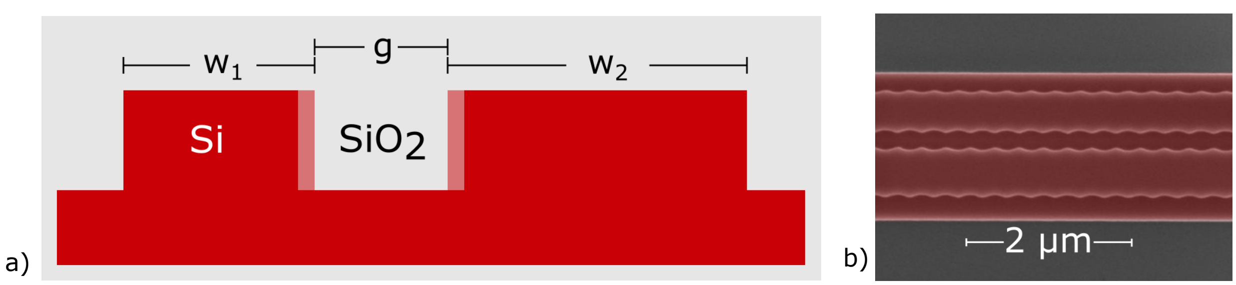


Figure 1. Schematic cross-section and colored microscope top view of the grating (a) The contra-directional coupler is made of two silicon waveguides of different widths $w_1$ and $w_2$ with an average gap $g$ in-between them. The gap varies along the propagation axis. (b) SEM image shows the shape of the corrugations after fabrication with ultraviolet lithography.

The contra-directional coupler consists of two waveguides in close proximity, with a periodic change to the gap in-between them. This causes a wavelength selective contra-directional coupling at $\lambda_c = \Lambda(n_1+n_2)$, where $\Lambda$ is the grating pitch, and $n_1$ and $n_2$ are the effective refractive indices of the first-order and second-order eigenmodes in the coupler. The waveguides are highly asymmetric to suppress the co-directional coupling that occurs with two identical waveguides.

### 2.2. *Fabrication process*

Fabrication using a CMOS compatible UV lithography with a phase-shifted mask.

### 2.3. *Fabrication result*

Clear corrugations and the possibility to have a small gap under 140 nm.

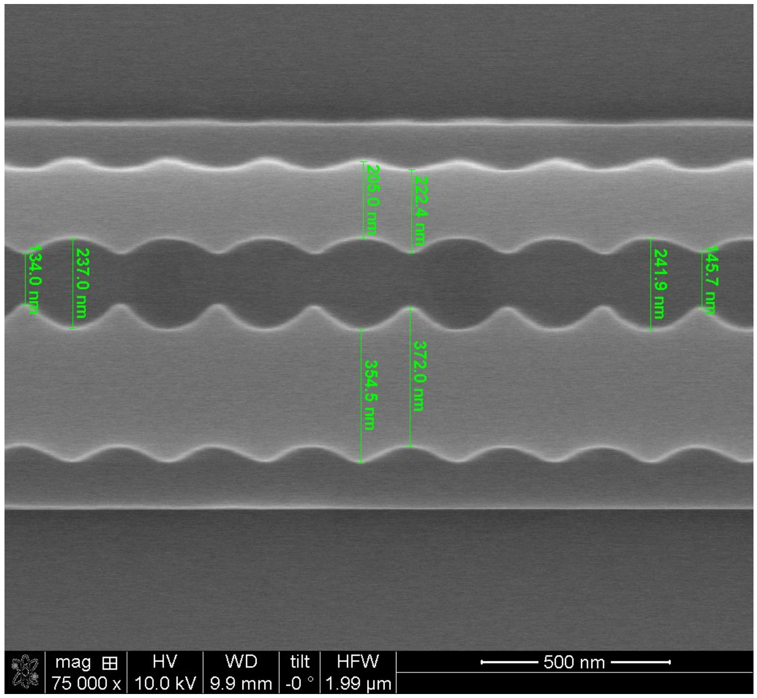


Figure 2. SEM picture of a strong grating. The measurements show that the widths of the waveguides are not the same in the close and far region, resulting in a strong change of index along the propagation direction and a distortion of the apodization profile.

### 2.4. *Filter optical performance*

[Plot of the optical response ]

### 2.5. *WDM performance*

[Plot of WDM at 1310 and 1550]

### 2.6. *WDM performance*

[Plot of WDM at 1310 and 1550]

## 3. Conclusion

The demonstrated device open possibilities for wide bandwidth and temperature tolerant filters with a flat top response. Next prototypes promise to offer even larger bandwidth and a more square shape after biasing for lithography.

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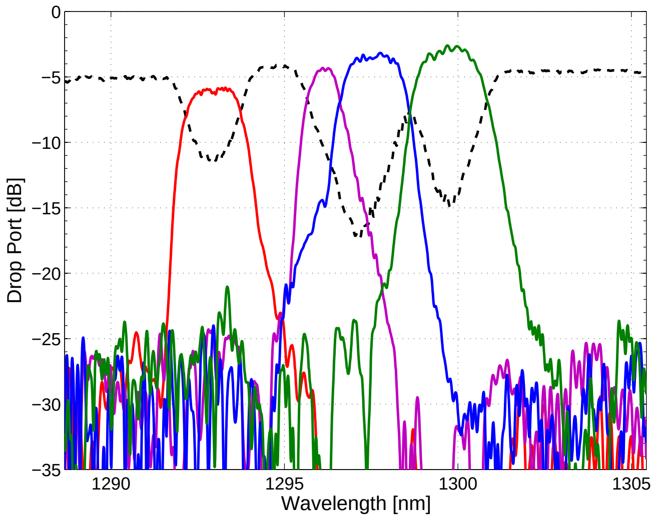


Figure 3. Single stage WDM

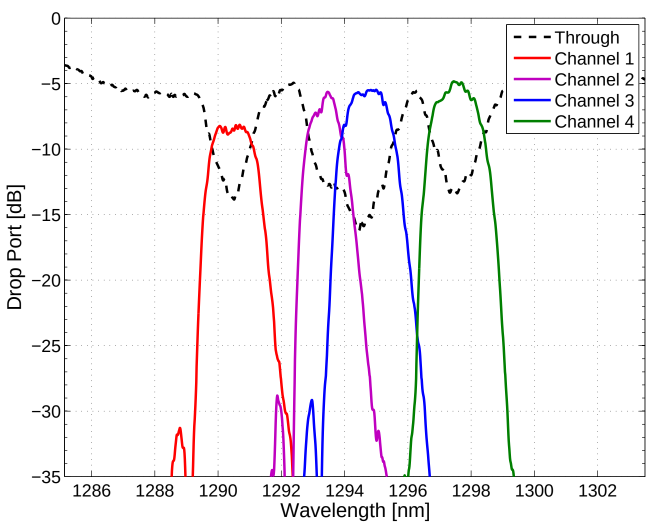


Figure 4. Double stage WDM