

## A Novel Grating-Apodization Technique in Equivalent-Chirped Sampled-Bragg Gratings

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Chirped Bragg gratings play an important role in photonics as broadband reflection filters and dispersion-management devices. In order to achieve a flat in-band reflection and a smooth dispersion curve, grating apodization is required, i.e., a gradual increase and then a decrease in the grating strength along the grating direction. Apodization was achieved in sidewall gratings by varying the depth etched into the sidewall [1]. This method, which relies on precision scanning-electron-beam lithography (SEBL), has not been widely adopted.

Previously, we described the Sampled-Bragg-Grating (SBG) technique to achieve quarter-wave phase-shifted gratings [2] and equivalent-chirped gratings [3]. Interference lithography was used to produce the grating and optical-contact lithography for the sampling. Figure 1 illustrates the structure of an equivalent-chirped Bragg grating using the SBG technique. Grating apodization can also be achieved with the SBG technique since grating strength depends on the ratio  $P'(z)/P(z)$ , defined in Fig. 1. Adjustment of the length of the grating  $P'(z)$  in each sampling segment does not require high-resolution lithography, and hence can be accomplished using optical-contact lithography. Figure 2(a) simulates the reflection spectrum of a chirped SBG without grating apodization, showing in-band reflection roughness and group-delay fluctuation. Figure 2(b) simulates the reflection spectrum using the proposed grating apodization technique, showing a flat in-band reflection and smooth group delay. Figure 3 shows SEM images of a sampled Bragg grating. Fabrication techniques and optical characterization of the equivalent-chirped SBG, with and without the proposed apodization technique, will be reported.

### **References:**

- [1] J. T. Hastings, M. H. Lim, J. G. Goodberlet, and H. I. Smith, *J. Vac. Sci. Technol. B*, 20(6), 2002
- [2] J. Sun, C. W. Holzwarth, and H. I. Smith, *IEEE Photon. Technol. Lett.*, 24(1), 2012
- [3] J. Sun, M. Qi, and H. I. Smith, in *EIPBN*, Las Vegas, NV, 2011

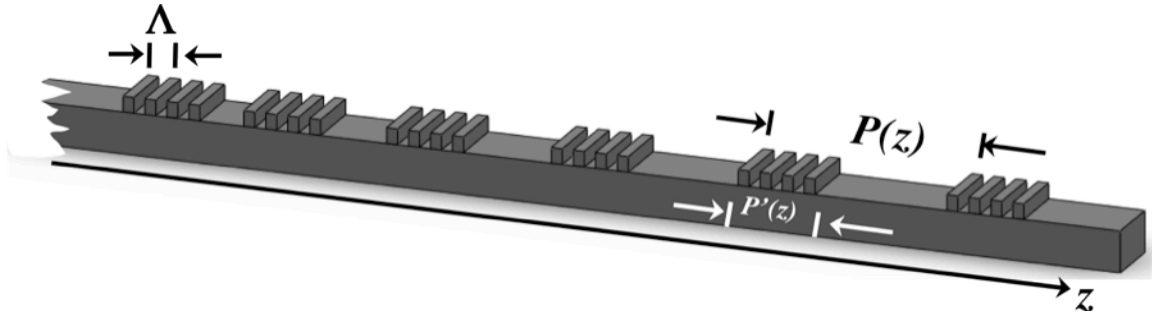


Fig. 1 Schematics of an equivalent-chirped Sampled-Bragg Grating (SBG).

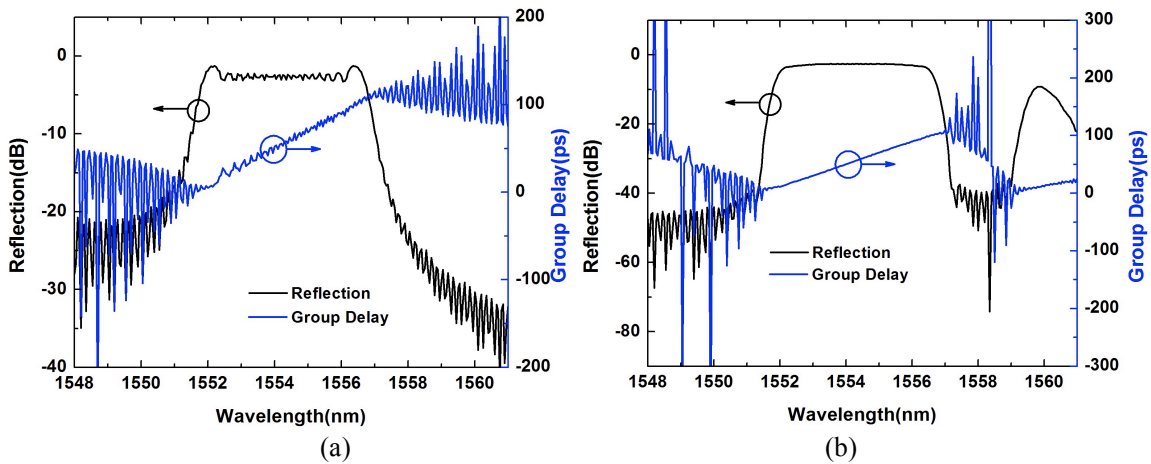


Fig. 2 Simulation of equivalent-chirped sampled Bragg gratings: (a) without apodization; (b) with the proposed apodization.

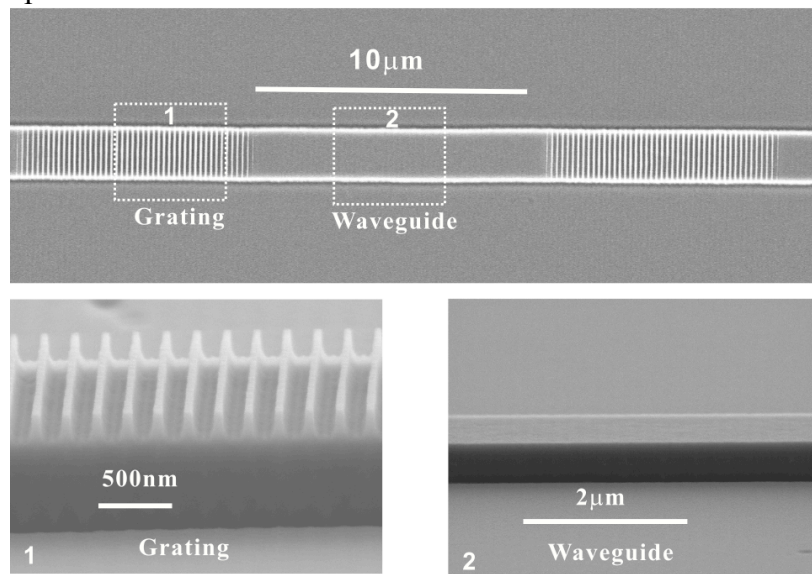


Fig. 3 Scanning-electron micrographs of sampled-Bragg grating: (a) top-view; (b) a zoom-in view of the section with sampling modulation; (c) without sampling modulation.