CHAPTER 6

SUMMARY

6.1 SUMMARY

In this dissertation, we have demonstrated a novel technique for retrieving the refractive-index profile of a fiber grating with any well-behaved chirp, apodization and dc component. In the technique, we designed a reconstruction process to obtain the longitudinal effective refractive-index profile from reflection spectra base on the coupled-mode equations and Fourier transformation. In our experiment, we used a balanced Michelson interferometer to measure the amplitude and phase of the reflection spectrum of a fiber grating. Two purposely designed fiber gratings were used to demonstrate the capability of this technique and the results agreed well with the fabrication conditions.

Also, we have theoretically analyzed the self-matching property in an APM fiber laser formed with fiber gratings. The physical origin of the self-
matching mechanism was found to be the wavelength-dependent delay properties of a fiber grating. Meanwhile, we extended this mechanism to an APM fiber laser with its cavities formed with apodized chirped fiber gratings. In addition to more efficient self-matching effect, an APM fiber lasers formed with apodized chirped fiber gratings with specially designed grating polarities can have the advantage of stretched-pulse amplification. The output pulses from such a laser are positively chirped and can be compressed through a fiber compressor. In this way, we have successfully generated mode-locked pulses with a pulsewidth of 930 fsec.

### 6.2 Suggestion for Future Work

Although there were several models proposed for the physical origin of the formation of photo-induced index change, no conclusion was reached yet. If we can make *in situ* measurements of the refractive index profiles while fabricating fiber gratings under UV laser exposure, clues might be obtained for understanding the physical mechanism behind index change formation. Compared with the existing measurement techniques for obtaining the index profiles of fiber gratings, our measurement setup is more suitable for *in situ* studying during the fabrication process.

Regarding the additive-pulse mode-locked fiber laser formed with fiber gratings, there are several interesting issues deserving further investigation.
First, the output pulse can be further compressed if the grating chirp is stronger. The dependencies of the output pulse energy and width on the grating chirp, pump power, and grating polarity need to be studied. Meanwhile, it is expected that any mild external disturbance causing cavity length change can be tolerated due to the cavity length self-matching mechanism. The stability of such a laser system needs to be studied.