FLAT FILTER BASED ON A CHIRPED SUPER MOIRÉ GRATING

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Abstract

In this paper, super Moiré grating (SMG) with multiple superimposed gratings, in the best of our knowledge, is studied at first time. A flat multichannel transmission filter based on a chirped SMG with three superimposed gratings can be achieved, which benefits wavelength-division multiplexing (WDM) system. At the same time, a reflection filter can also be obtained in a chirped SMG, which can be used as an optical add/drop multiplexer filter for WDM system.

Key words: fiber Bragg gratings, filter, multichannel filter, WDM

I. Introduction

Filter selecting different wavelength channels is a key element for wavelength-division-multiplexing (WDM) fiber telecommunication system. Filters based on fiber Bragg gratings have attracted much attention for their compaction, low cost, simple fabrication and easy integration with the fiber. Among them, multichannel fiber filters are of special importance for WDM systems. A Moiré grating (MG) is composed of two superimposed gratings at different wavelengths. When
the gratings are strongly chirped, there may be multiple passbands in the structure [1]. However, there are some non-ideal filtering characteristics in the structure, such as Lorenzian passbands with sharp peaks and broad bottom areas. A careful design by embedding constant refractive index areas in the grating is proposed to overcome this disadvantage [2,3]. On the other hand, an acoustic-modulation fiber grating can be regarded as a special grating that is composed of a series of ghost gratings [4]. Such a grating can be considered as a super Moiré grating (SMG) that is composed of multiple (>2) superimposed ghost gratings. The structure is then an equivalent SMG. However, in the best of our knowledge, a real SMG with multiple superimposed gratings has been not carefully studied. In this paper, we study a real SMG with three superimposed gratings. When the SMG is strongly chirped, there are also multiple passbands and stopbands in the structure. We have found that a flat filter based on SMG, which can work as either a transmission filter or a reflection filter, can be obtained. Filters that work as transmission filters can be used to minimize effects of the amplified spontaneous emission (ASE) of erbium-doped fiber amplifiers (EDFA), at the same time filters that work as reflection filters can be used as multichannel optical add/drop multiplexer filters (OADM) [5].

II. Results and Discussion

A SMG is composed of multiple superimposed gratings at different wavelengths. It can be expressed as

\[ n(z) = n_0 + \sum_{i}^{M} \delta n_i \cos \left( \frac{2\pi}{\Lambda_i} z + \phi_i \right) \]  

(1),

where \( n_0 \) is the average refractive index of the fiber, \( i \) indicates the \( i \)th refractive index modulation \((i=1,2,\ldots,M)\), \( z \) is the coordinate along the grating, \( M \) is the number of refractive index modulation, \( \delta n_i \) is the modulation strength, \( \Lambda_i \) is the period in the grating and \( \phi_i \) is the constant phase, respectively. In this paper, the spacing

![Graph of Transmission spectrum of a chirped MG](image)

Fig.1 Transmission spectrum of a chirped MG, \( l=20\text{mm}, c=1.3\times10^{-4}\text{mm}^{-1}, \delta\lambda_B=0.12\text{nm}, \delta n_1=\delta n_2=2\times10^{-4}. \)