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STUDY OF INTENSITY DEPENDENT REFLECTION, TRANSMISSION AND DISPERSION PROPERTIES OF NONLINEAR FIBER BRAGG GRATING

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ABSTRACT

We have reported the results of an analytical study of nonlinear reflection, transmission and dispersion characteristics of fiber Bragg grating at high excitation intensity. The nonlinear coupled mode equations have been solved analytically to obtain the expression of nonlinear dispersion relation, reflectivity, transmittivity, first, second and third order dispersion parameter of fiber Bragg grating under nonlinear regime. The study reveals that the stop band at the Bragg wavelength shifts towards higher wavelength side with increasing excitation intensity and splits into equally train of pulses at a specific input intensity. It is also studied that the intensity of the input beam modifies the dispersion properties of fiber Bragg grating. These intensity dependent features of Bragg grating can be utilized as a tunable optical notch filter and dispersion compensation with huge potentiality in the current optical signal processing applications.

Keyword—Reflection, Transmission, Dispersion, fiber Bragg Grating, Optical Filter.

I. INTRODUCTION

The development of the future generation of all-optical nonlinear components demands optical fiber based devices that are tunable and compact to achieve multifunction with high degree of efficiency. Nonlinear fiber Bragg gratings (FBGs) are remarkable devices to include all the above requirements. The presence of Kerr nonlinearity in the medium, the intensity of the incident wave can sufficiently modify the nonlinear index of refraction to shift the stop band and permit many interesting nonlinear phenomena such as optical bistability, multistability, switching and limiting etc. [1]. Winful et al [2] for the first time demonstrated that nonlinear periodic structure can convert an input CW beam into a train of pulses which are generally unstable above threshold intensity. Sterke [3] provided stability analysis of nonlinear periodic structure and investigated a region where the system is unstable formation of sideband and exhibit self pulsation leading to a periodic stream of gap solitons. Eggleton [4] experimentally observed that at high input intensities a FBG converts a single input pulse into a pair of pulses. Such multiple pulses are generated through a modulational instability by operating at frequencies outside of the photonic bandgap.

Recently, Parini et al [5] characterized the Hopf bifurcations that rule self puling of spatially varying fields in distributed feedback structure with Kerr nonlinear response. In recent years, the nonlinear optical properties of FBGs have received increased interests because of their potential applications like switching, bistability, optical limiting, soliton propagation and pulse shaping through dispersion compensation [6-9].

The present work deals with the analytical study of dispersion and reflection, transmission properties of fiber Bragg grating under nonlinear regime. Using nonlinear coupled mode equations, we have obtained the intensity dependent expression for first second and third order dispersion as well as reflectivity and transmittivity of fiber Bragg grating. The work in this paper summarizes as follows: In section II we describe the theoretical model to obtained the expression of nonlinear dispersion relation. In Section III,

The reflectivity of the FBG has been obtained considering the propagation of continuous wave. The occurrence of self phase modulation in the grating has also been discussed. In Section IV the transmission properties of FBG under nonlinear regime for a quasi CW laser beam. The result shows that the stop band splits into series of pulse like train at specific input intensity. The optical pulses generated continuously with same intensity and same spacing wavelength. A intensity dependent first, second and third order dispersion properties of FBG are presented in Section

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V. The results show that the dispersion properties of FBG are modifies with excitation intensity. In this particular we show how FBG is used as a dispersion compensator in optical communication system.

II. Theoretical Model for Coupled Mode Equation under Nonlinear Regime

Fiber Bragg grating is a periodic structure that has alternated high and low refractive indices along the length of the core of the single mode optical fiber. When light propagates through such a periodic structure, it couples forward and backward propagating modes and mode coupling occurs at the Bragg wavelength $\lambda_B = 2n\Lambda$ (where n is the total refractive of FBG index and Λ is the grating period). As a result, a narrow band of wavelengths satisfying the phase matching condition is reflected back and remaining wavelengths are transmitted showing that FBG acts as a band rejection/pass filter at low excitation intensity. The reflected band of frequencies is commonly referred to as a stop band. The central wavelength of the stop band is known as Bragg wavelength and corresponds to the condition where the wavelength of the light inside the structure is equal to one half the period of the dielectric layer. This condition is known as the Bragg resonance. Complete study of wave propagation in FBG is generally described by the coupled mode theory.

In order to examine the characteristics of the outcoming backward or forward propagating modes under nonlinear regime, following pair of nonlinear coupled mode equations have been used which are given as:

$$\frac{\partial A_f}{\partial z} + \beta_1 \frac{\partial A_f}{\partial t} + \frac{i\beta_2}{2}\frac{\partial^2 A_f}{\partial t^2} + \frac{\alpha}{2} A_f = i\delta A_f + i\kappa A_b + i\gamma(|A_f|^2 + 2|A_b|^2)A_f, \quad (1)$$

and

$$-\frac{\partial A_b}{\partial z} + \beta_1 \frac{\partial A_b}{\partial t} + \frac{i\beta_2}{2}\frac{\partial^2 A_b}{\partial t^2} + \frac{\alpha}{2} A_b = i\delta A_b + i\kappa A_f + i\gamma(|A_b|^2 + 2|A_f|^2)A_b. \quad (2)$$

In these equations, β_1 and β_2 are first- and second- order dispersion parameter related to the group velocity v_g and α is the loss coefficient. δ, κ and γ are detuning parameter, coupling coefficient and nonlinear parameter, respectively, and are given by

$$\delta = 2\pi n_0\left(\frac{1}{\lambda} - \frac{1}{\lambda_B}\right), \quad \kappa = \frac{\pi n_g}{\lambda_B} \quad \text{and} \quad \gamma = \frac{2\pi n_2}{\lambda_B}.$$

In the steady state CW nonlinear regime, , β_1 and β_2 are neglected in equations (1) and (2). For typical grating lengths (<1m), the loss coefficient α can also be neglected. With these assumptions, NLCMEs take the simplified forms:

$$i\frac{\partial A_f}{\partial z} + \delta A_f + \kappa A_b + \gamma(|A_f|^2 + 2|A_b|^2)A_f = 0, \quad (3)$$

$$-i\frac{\partial A_b}{\partial z} + \delta A_b + \kappa A_f + \gamma(|A_b|^2 + 2|A_f|^2)A_b = 0. \quad (4)$$

The preliminary solution of NLCMEs was reported by Agrawal et al [8] where they predicted the red/blue shift in the stop band depending on the positive/negative nonlinearity of refractive index. In the following analysis we have obtained the analytical solution of NLCMEs by neglecting higher order terms of backward propagating mode in Equation (3). The solutions of equations (3) and (4) are obtained as

$$A_f(z) = A_1 \exp(iSz) + A_2 \exp(iTz), \quad (5)$$

$$A_b(z) = B_1 \exp(iSz) + B_2 \exp(iTz) \quad (6)$$

with $S = -\gamma I_0 + \frac{\sqrt{\gamma^2 I_0{}^2 + 4q_{nl}^2}}{2}$ and $T = -\gamma I_0 - \frac{\sqrt{\gamma^2 I_0{}^2 + 4q_{nl}^2}}{2}$.

Here, $I_0 = |A_f|^2 + |A_b|^2$ is the input intensity at Bragg wavelength λ_B .The coefficients A_1, A_2, B_1 and B_2 are interdependent and satisfy the following four relations:

$$(\delta - S + \gamma|A_f|^2)A_1 = -\kappa B_1, \quad (7a)$$

$$(S + \delta + \gamma|A_b|^2 + 2\gamma|A_f|^2)B_1 = -\kappa A_1, \quad (7b)$$

$$(\delta - T + \gamma|A_f|^2)A_2 = -\kappa B_2, \quad (7c)$$

$$(T+\delta+\gamma|A_b|^2+2\gamma|A_f|^2)B_2=-\kappa A_2 \qquad (7d)$$

Equations (7) are satisfied for nonzero values of coefficients A_1, A_2, B_1 and B_2 if the possible values of q_{nl} obey the nonlinear dispersion relation

$$q_{nl}=\pm\sqrt{q^2+\delta\gamma\left(I_0+2|A_f|^2\right)}, \qquad (8)$$

with $q(=(\delta^2-\kappa^2)^{1/2})$ being the linear dispersion parameter for the Bragg grating. Equations (3.8) exhibit the intensity dependent modification in the dispersion parameter. Consequently, we find that for frequency detuning δ lying in the range $-\kappa<\delta\left(1+\frac{X}{\delta}+\frac{Y}{\delta^2}\right)^{1/2}<\kappa,$ q_{nl} becomes purely imaginary and most of the incident field will be reflected due to the fact that the grating will not support the propagating wave. In the absence of nonlinearity $(\gamma=0)$ the stop band extends for $-\kappa<\delta<\kappa$ and equations (8) resemble to the standard solutions of the coupled mode equations for Bragg grating under linear regime. In order to examine intensity dependent reflection characteristics of the grating we have obtained the analytical solution for the amplitude of forward and backward propagating modes using equations (5) and (6) as

$$A_f(z)=A_1\exp(iSz)+r_{nl}B_2\exp(iTz), \qquad (9)$$

$$A_b(z)=B_2\exp(iTz)+r_{nl}A_1\exp(iSz). \qquad (10)$$

Here, r_{nl} is the effective reflection coefficient in nonlinear regime and using equation (3.7) in equation (3.9) and (3.10) it is found to be

$$r_{nl}=-\frac{\kappa}{S+\delta+\gamma\left(I_0+|A_f|^2\right)}. \qquad (11)$$

III. Reflection Properties of Fiber Bragg Grating under Nonlinear Regime

To study the reflection properties under nonlinear regime we apply the sutaible boundary conditions that light is incident only at the front end at $z=0$ of the FBG as shown in Figure 2.1, the nonlinear reflection coefficient r_{ng} for a nonlinear grating of length L has been obtained by using equations (7) to (11) as

$$r_{ng}=\frac{A_b(z=0)}{A_f(z=0)}=\frac{-\kappa\psi[1-\exp(i2\Phi)]}{\psi^2-\kappa^2\exp(i2\Phi)} \qquad (12)$$

where $\Phi=kL/2$, $\Psi=\left(\frac{k}{2}+\tau\right)$, $\tau=\delta+\gamma|A_f|^2$ and $k=\sqrt{\gamma^2I_0^2+4q_{nl}^2}$.

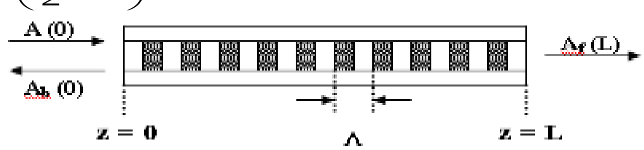

Figure 1: Schematic of a FBG of length L illuminated by electromagnetic field of amplitude A(z) .

The corresponding expression for the reflectivity $R_{ng}\left(=|r_{ng}|^2\right)$ in the nonlinear regime is

$$R_{ng}=\frac{4\kappa^2\psi^2\sin^2\Phi}{(\psi^2-\kappa^2)^2+4\kappa^2\psi^2\sin^2\Phi} \qquad (13)$$

In this section, we have discussed the effect of high excitation intensity on the reflectivity of FBG. Equations (9) to (13) reveal that the condition of the transparency of the Bragg grating gets modified at large excitation intensity. The reason for this can be attributed to the intensity dependence of the dispersion parameter q which becomes nonlinear. The intensity dependent changes in the reflectivity of FBG is plotted in Figure 2 using the following FBG parameters of chalcogenide glass; effective mode refractive index n_{eff} = 2.45, Bragg grating design at wavelength λ_B = 1550 nm, nonlinear refractive index n_2 = 2.7×10^{-17} m^2/W, induced refractive index change n_g = 1×10^{-4} and grating length as 5 mm. In this figure, the curves a ,b, c, d and e represents the reflectivity of fiber Bragg grating at incident intensity 0.01 GW/cm^2, 5 GW/cm^2, 15 GW/cm^2, 25 GW/cm^2 and 35 GW/cm^2, respectively. One can notice two important features from these figures. Firstly, the Bragg wavelength λ_B at which peak reflectivity occurs exhibits a red shift equivalent to $2n_2|E|^2\Lambda$. Secondly, one can observe that at higher input intensities ($\geq$ 5 GW/cm^2), splitting in the stop band (reflection band) occurs. It is clearly from the Figure (2) that as the input intensity increases the stop band shifts toward the higher wavelength side. When the input intensity is 0.01 GW/cm^2 (Fig. 2(a)), the behavior of the grating is linear and as the input intensity exceeds to this intensity, behavior of the grating becomes nonlinear due to the contribution of intensity dependent refractive index. At sufficiently high excitation intensity of 35 GW/cm^2, two equally intense reflected pulses are observed. The peak wavelengths and FWHM of these pulses and spacing between them depend upon the values of κL. It is also worthy to note that at an intensity of 35 GW/cm^2 the central peak splits while the side lobes become almost same as that under the linear regime.

Such splitting have also been reported in optical fibers as well as in FBG at high excitation intensity due to the effect of modulational instability (MI) which is a well known phenomenon in nonlinear wave propagation studies causing CW fields to be unstable.

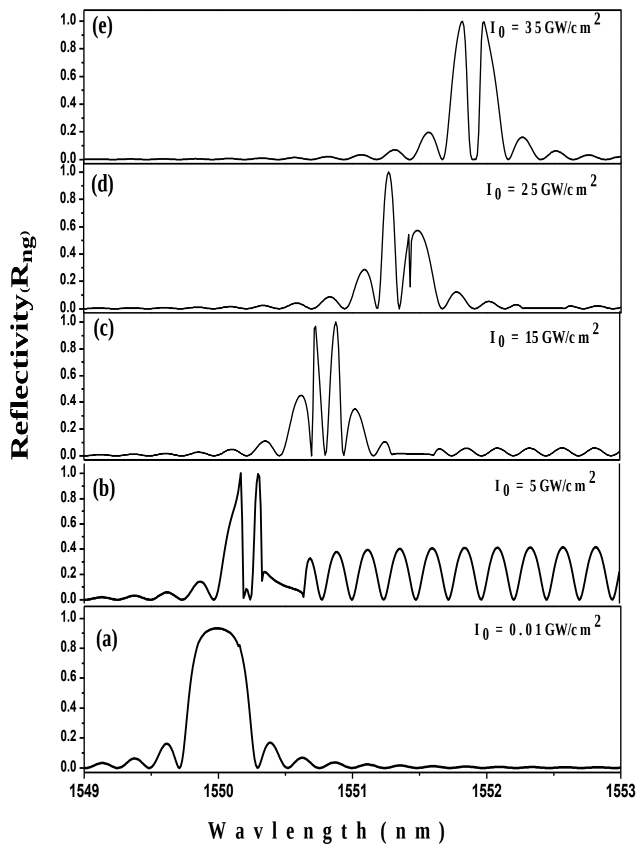

Figure 2: Reflectivity (R_{ng}) as a function of wavelength and input intensity for uniform fiber Bragg grating with κL ≈ 2

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In Figures 2, the reflection spectra of the FBGs at input intensity of 35 GW/cm^2 are showing two pulses which can be realized as a notch filter at wavelengths of 1551.80 nm and 1552 nm with the width of the notch being Δλ = 0.10 nm. This filter can play a vital role in modern optical communication systems like WDM and DWDM where optical filters with ultra narrow bandwidth in the range of 0.2 nm to 0.5 nm are required.

IV. TRANSMISSION PROPERTIES OF FIBER BRAGG GRATING UNDER NONLINEAR REGIME

Equations (8) exhibit the intensity dependent modification in the dispersion parameter q_{nl}. On substituting parameter q_{nl} in equations (5) and (6), the fields of forward and backward propagating modes for the transmitted wave have been obtained as

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$$A_f(z) = A_1 \exp(iS_1 z) + t_{eff} B_2 \exp(iS_2 z) \qquad (14)$$

$$A_b(z) = B_2 \exp(iS_2 z) + t_{eff} A_1 \exp(iS_1 z). \qquad (15)$$

In the above equations, t_{eff} is the effective transmission coefficient under nonlinear regime and on mathematical simplification, one finds

$$t_{eff} = -\frac{\kappa}{S_1 + \delta + \gamma(I_0 + |A_f|^2)}. \qquad (16)$$

The equation (14) and (15) gives the solution to the coupled mode equations in exponential form. The transmission coefficient of fiber Bragg grating under nonlinear Kerr regime can be calculated by using equations (14) and (15) with the appropriate boundary conditions as

A_b (z = 0) = 0 and A_f (z = L) = 1 for $\delta \neq 0$ (17)

where L is the length of the grating and δ is detuning parametr and taken $\lambda \neq \lambda_B$. The above boundary condition implies that the amplitude of the transmitted wave at z = L is unity (say). We defined the transmission coefficient (t_{ng}) of the FBG by the ratio of the amplitude of transmitted wave at z = L to the amplitude of incident wave at z = 0 using equations (14) and (15) as

$$t_{ng} = \frac{A_f(z=L)}{A_f(z=0)} = \frac{A_1 \exp(iS_1 L) + t_{eff} B_2 \exp(iS_2 L)}{A_1 + t_{eff} B_2} \qquad (18)$$

If we use the boundary condition $A_b(L) = 0$ in equation (3.15),

$$B_2 = -t_{eff} A_1 \exp(ikL) \qquad (19)$$

Using equation (3.15) and equation (3.19) in equation (3.18), we obtained the transmission coefficient in nonlinear Kerr regime as

$$t_{ng} = \frac{A_f(z=L)}{A_f(z=0)} = \frac{(k'^2 - \kappa^2)\exp(iS_1 L)}{k'^2 - \kappa^2 \exp(ikL)} \qquad (20) \qquad \text{with} \quad k' = \left(\frac{k}{2} + \tau\right),$$

$\tau = \delta + \gamma |A_f|^2$ and $k = \sqrt{\gamma^2 I_0^2 + 4q_{nl}^2}$.

The above formalism yields the expression for the transmittivity $T_{ng} \left(= |t_{ng}|^2\right)$ in the FBG acting like a nonlinear optical material as

$$T_{ng} = \frac{1}{1 + F' \sin^2(\Phi'/2)} \qquad (21)$$

On the basis of the theoretical formulations developed in the preceding sections (Equation 20 and 21), we have evaluated the previous derived formulism by plotting the transmittivity as a function of wavelength for different input intensity in Figure 2.3. Looking to the potentiality of the chalcogenide glass as FBG materials for nonlinear applications, we have made the numerical analysis with physical parameters of chalcogenide glass as effective index n_{eff} = 2.45, change in grating index $n_g = 1\times10^{-4}$, nonlinear Kerr coefficient $n_2 = 2.7\times10^{-17}$ m^2/W. The length of the grating L = 0.5 cm ($\kappa L \approx 1$) and Bragg wavelength λ_B = 1550 nm were chosen. In numerical analysis, we have illuminated a light at wavelengths band from 1549.5 nm to 1551 nm. The intensity dependent changes in the transmittivity of FBG are plotted in Fig. 3 using equation (21) for κL ≈ 1. The curves a, b and c represents the reflectivity of fiber Bragg grating at incident intensity 0.001 GW/cm^2, 0.1 GW/cm^2 and 0.4 GW/cm^2, respectively. One can notice two important features from these figures. Firstly, the Bragg wavelength exhibits a red shift; secondly, one can observe that at higher input intensities splitting in the stop band. Such splittings have also been reported in optical fibers as well as in FBG at high excitation intensity due to the effect of modulational instability which is a well known phenomenon in nonlinear wave propagation studies causing CW fields to be unstable.

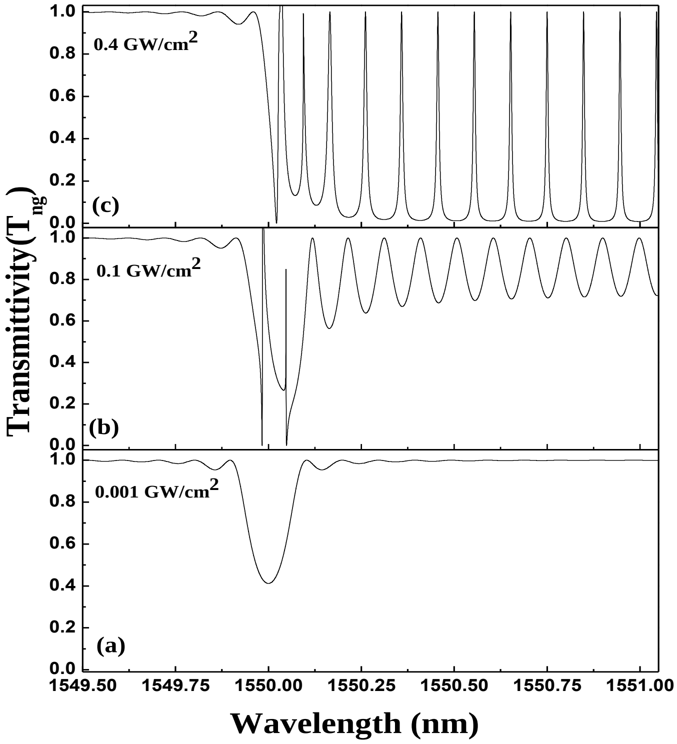

Figure 3: Transmittivity of nonlinear FBG as a function of wavelength with κL ≈ 1 at three input intensities of 0.001 GW/cm² ***(curve a), 0.1 GW/cm²*** ***(curve b) and 0.4 GW/cm²*** ***(curve c).***

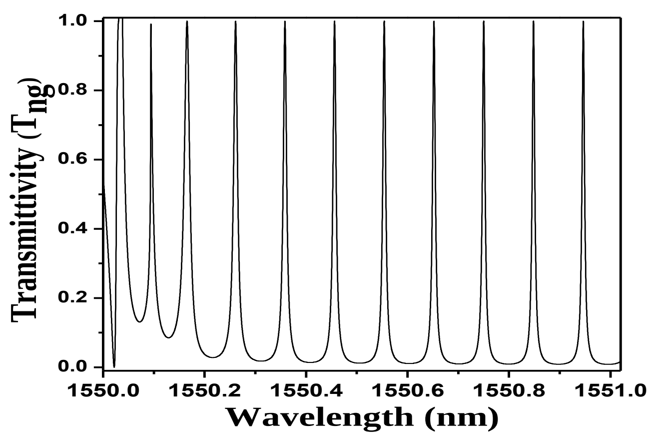

Figure 4: Transmittivity (T) of nonlinear FBG as a function of wavelength with κL ≈ 1 at input intensity of 0.4 GW/cm².

In Fig. 4, the transmission spectra of the FBG at input intensity of 0.4 GW/cm^2 is plotted in the wavelength range 1550 nm to 1551 nm. It is show that the beam converted into train of pulses with maintain spacing 0.1 nm between two pulses and the width of the pulses being $\Delta\lambda$= 8 pm (0.008 nm). All the pulses has resonance wavelength is almost unity. These pulses can play a vital role in modern optical communication systems like WDM and DWDM where optical filters with ultra narrow bandwidth in the range of 0.1 nm to 0.2 nm are required.

V. INTENSITY DEPENDENT DISPERSION PROPERTIES OF FBG

The induced dispersive properties by the FBG can be defined by expanding the parameter β_e in a Taylor series around the carrier frequency ω_0 of the wave, we get

$$\beta_e = \beta_0^g + (\omega-\omega_0)\beta_1^g + \frac{1}{2}(\omega-\omega_0)^2\beta_2^g + \frac{1}{6}(\omega-\omega_0)^3\beta_3^g + --- \quad (22)$$

where β_m^g is defined as

$$\beta_m^{ng} = \frac{d^m q_{nl}}{d\omega^m} \approx \left(\frac{1}{v_g}\right)^m \frac{d^m q_{nl}}{d\delta^m}. \quad (23)$$

Here, q_{nl} is defined in Equation (8) known as nonlinear dispersion relation. Is referred as m^th^ order (with m =1, 2, 3....) dispersion parameter. Here, derivatives are evaluated at $\omega = \omega_0$. The superscript ng correspond the nonlinear grating.

a) First Order Dispersion of the FBG under Nonlinear Regime

The first order dispersion parameter of FBG under nonlinear regime can be obtained using Equations (23) and (8) as

$$\beta_1^{ng} == \left(\frac{1}{v_g}\right)\frac{dq_{nl}}{d\delta} = \left(\frac{1}{v_g}\right)\frac{\delta + \gamma I_0 + 2\gamma|A_f|^2}{\sqrt{\delta^2 - \kappa^2 + \delta\gamma I_0 + 2\delta\gamma|A_f|^2}}. \quad (24)$$

Equation (24) shows intensity dependent expression of first order dispersion of FBG. After setting the nonlinear parameter γ=0 the Equation (24) resembles in linear first order dispersion of FBG. The evaluation of first order dispersion parameter is shown in Figure 5, where parameter β_1^{ng} is plotted as a function of wavelength (λ) with κ = 1 cm^{-1} at three input intensities of 0.001 GW/cm^2 (dotted curve), 0.2 GW/cm^2 (dashed curve) and 0.5 GW/cm^2 (solid curve).

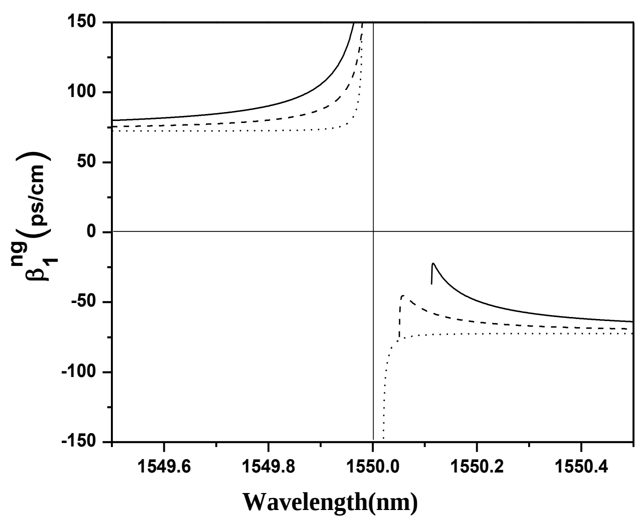

Figure 5: First order dispersion of FBG is plotted as a function of wavelength with κ = 1 cm^{-1} at three input intensities of 0.001 GW/cm^2 (dotted curve), 0.2 GW/cm^2 (dashed curve) and 0.5 GW/cm^2 (solid curve).

In all such cases we have considered the effective index $n_0 \approx 2.17$, grating index $n_g \approx 0.0495\times10^{-3}$ and Bragg wavelength $\lambda_B \approx$ 1550 nm. It is clear from the figure that the dispersion properties are modified with input intensity of incident wave. The excitation intensity of the wave increases the value of dispersion it is shown in figure 5.

b) Second Order Dispersion of the FBG under Nonlinear Regime

The intensity dependent second order dispersion parameter β_2^{ng} is calculated using Equations (3.22) and (3.8) as

$$\beta_2^{ng} == \left(\frac{1}{v_g}\right)^2 \frac{d^2 q_{nl}}{d\delta^2} = \frac{\mathrm{sgn}(\delta)\dfrac{\kappa^2}{v_g^2}}{\left(\delta^2 - \kappa^2 + \delta\gamma I_0 + 2\delta\gamma|A_f|^2\right)^{\frac{3}{2}}} \qquad (25)$$

Equation (25) shows intensity dependent expression of second order dispersion parameter of FBG. After setting the nonlinear parameter γ=0 the Equation (25) resembles in linear first order dispersion of FBG.

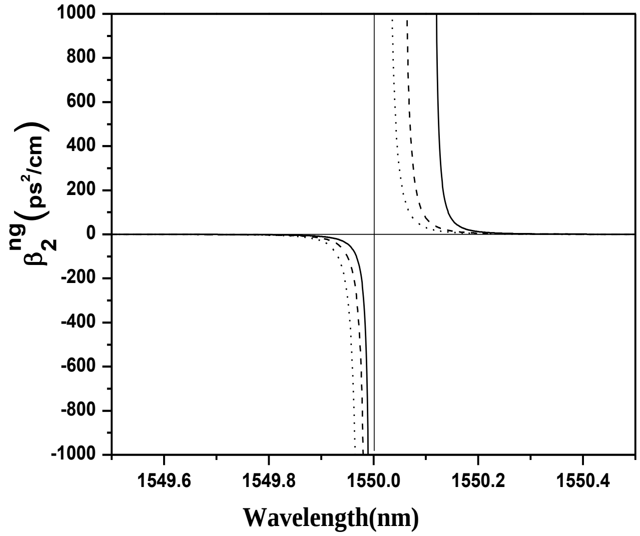

Figure 6: Second order dispersion of FBG is plotted as a function of wavelength with κ = 1 cm⁻¹ at three input intensities of 0.001 GW/cm² (dotted curve), 0.2 GW/cm² (dashed curve) and 0.5 GW/cm² (solid curve).

The evaluation of second order dispersion parameter is shown in Figure 6, where parameter β_2^{ng} is plotted as a function of wavelength (λ) with κ = 1 cm^{-1} at three input intensities of 0.001 GW/cm^2 (dotted curve), 0.2 GW/cm^2 (dashed curve) and 0.5 GW/cm^2 (solid curve). It is clear from the figure that the dispersion property is modified with input intensity of incident wave. The excitation intensity of the wave increases the value of dispersion it is shown in figure 6. The input intensity of the beam shifted the dispersion to the higher wavelength side.

c) Third Order Dispersion of the FBG FBG under Nonlinear Regime

The intensity dependent third order dispersion parameter of fiber Bragg grating is given by β_3^{ng} . This parameter is obtained as

$$\beta_3^{ng} = \left(\frac{1}{v_g}\right)^3 \frac{d^3 q_{nl}}{d\delta^3} = \frac{3\dfrac{\kappa^2}{v_g^3}\left(|\delta| + \gamma I_0 + 2\gamma|A_f|^2\right)}{\left(\delta^2 - \kappa^2 + \delta\gamma I_0 + 2\delta\gamma|A_f|^2\right)^{\frac{5}{2}}}. \qquad (26)$$

The third-order dispersion β_3^g induced by FBG is plotted as a function of incident wavelength in Figure 7.

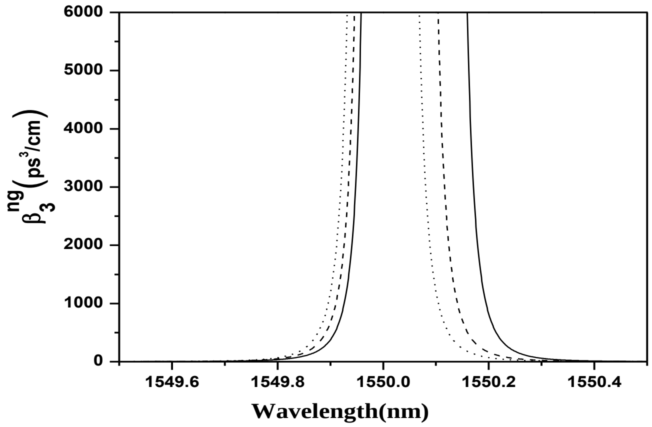

Figure 7: Third order dispersion of FBG is plotted as a function of wavelength with κ = 1 cm⁻¹ at three input intensities of 0.001 GW/cm² (dotted curve), 0.2 GW/cm² (dashed curve) and 0.5 GW/cm² (solid curve).

The evaluation of third order dispersion parameter is shown in Figure 7, where parameter β_3^{ng} is plotted as a function of wavelength (λ) with κ = 1 cm^{-1} at three input intensities of 0.001 GW/cm^2 (dotted curve), 0.2 GW/cm^2 (dashed curve) and 0.5 GW/cm^2 (solid curve). The contribution of β_3^g is very small as compared to second order dispersion parameter β_2^g. But in the case of ultra-short optical pulse propagation in high speed optical communication, it is important to consider the parameter β_3 even when $\beta_2 \neq 0$ The investigation of intensity dependent third order dispersion parameter is very important beacuase at high excitaion intensity the dispersion properties is modified.

VI. CONCLUSION

We have investigated analytically the intensity dependent reflection, transmission and dispersion characteristics of uniform fiber Bragg grating by incorporating the optical Kerr effect in nonlinear coupled mode equations. The expression for the intensity dependent reflectivity, transmittivity and first, second and third order dispersion parameter of fiber Bragg grating has been derived. The shifting and splitting of the Bragg wavelength have been found in reflection and transmission charaterstics due to the effect of self phase modulation. Also the dispersion properties of FBG are modified due to the contribution of Kerr nonlinearity at high input intensity. Finally, it is envisaged that the work presented in this chapter will be useful in understanding the experimental demonstration of intensity dependent tunable filter as well as dispersion compensation in nonlinear fiber Bragg grating for all-optical computing applications**.**

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