

Measurements of Nonlinear Coefficient in Optical Fibers with the CW-FWM method.

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The propagation of an optical signal through a fiber in high speed fiber optic transmission systems can give rise to nonlinear optical effects (NOE), since these arise even at minor intensities of light in the fiber. This is owing to the fact that the cross-section of the optical fibers (OF) employed in communication technologies is very small – 10^{-7} - 10^{-8} cm² for a single mode fiber – so the light intensities acting upon a fiber reach as much as several GW/cm².

Various methods are provided for measuring the nonlinear coefficient [1]. In this research we used continuous wave four wave mixing methods (CW-FWM) to determine optical fibers nonlinear coefficient in single mode fibers. We must evaluate ratio between new generated frequencies power and original frequencies power to calculate optical fiber nonlinear coefficient. Our simulation and experimental scheme employs two optical channels. The high power tunable laser sources with wavelength resolution 1pm (full-width-at-half-maximum (FWHM) of 50 MHz), reference wavelength $\lambda = 1550$ nm always switched on as pump and probe sources. One channel – pump source is amplified by the erbium-doped fiber amplifier (EDFA). The motorized polarization controller, and polarimeter were used to rotate the polarization of input light of pump source and depolarize to examine the depolarization effect on FWM. After amplification signal is sent to various type of optical fibers (SMF (G.652D), SSMF (G.652C) and DSF (G.653)), where optical pulses are propagating over a 1 km. For CW FWM method experiments and simulation results shows interconnection: enlargement of one laser power till 10 mW and amplification and attenuation of this channel gives that spectral components merge symmetrically from both sides of both channels. This means that generation of new spectral components is defined by total power of both lasers.

With CW FWM measuring method the following parameters have been determined experimentally: nonlinear coefficient n_2/A_{eff} and nonlinear refractive index n_2 ; accordingly, n_2/A_{eff} is calculated to be in the range $9.23 \cdot 10^{-11}$ - $1.01 \cdot 10^{-10}$ 1/W, whereas n_2 – in the range $2.27 \cdot 10^{-21}$ - $8.62 \cdot 10^{-21}$ m²/W depending of the fiber type. Result of SMF is shown in Fig. 1. However pulse self-phase-modulation (P-SPM) method is realized with more direct approach by defining nonlinear coefficient from SPM phase shift [2]. This ensures higher precision than CW FWM method.

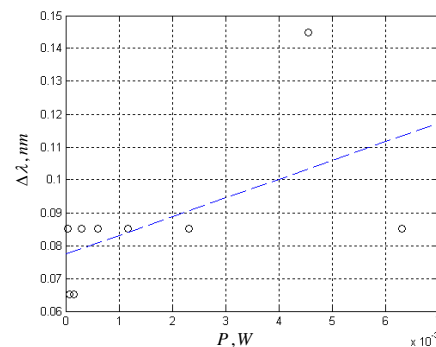


Fig.1 Measurement results with CW-FWM for SMF fiber.

References

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