

Optical Fiber Nonlinear Coefficient Measurements Using FWM

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Abstract— Telecommunication market needs for broadcasting channels determine the progress of development of high speed fiber optics telecommunication systems (FOTS). The total average demand for the data is increasing more and more rapidly [1].

Increasing data rates leads to much higher requirements to optical signal to noise ratio (OSNR) and bit error ratio (BER) which inevitably decreases as signal propagates along the optical fiber (OF) line due to linear effects (attenuation and dispersion) and non-linear effects. In addition nonlinear effects' influence is more dangerous because it is more complicated to compensate and it may eventually degrade an optical signal to be unrecognizable at the receiver.

Parameter that characterizes OF's nonlinearities is nonlinear coefficient γ . Traditional telecommunications OF's γ is not very high (around $2.5 \text{ W}^{-1} \text{ km}^{-1}$). But high optical radiation intensities in the OF core and long transmission distances lead to considerable nonlinear interaction. Therefore this parameter is very essential especially for the fibers that are used in high data rates FOTS.

In this research, γ parameter measurements using nonlinear phenomena four-wave mixing (FWM) are performed. Experimental measurement scheme is shown in the Fig. 1. Pump and signal laser wavelength are set to be in the OF's zero dispersion region to achieve better FWM interaction efficiency. It has been established that measured nonlinear coefficient value is decreasing according to increase in the pump and signal laser wavelength separation $\Delta\lambda$. This can be explained by phase matching condition deterioration as two optical components are located further away each from the other. Calculations are performed to find out exact $\Delta\lambda$ for which the γ parameter is constant.

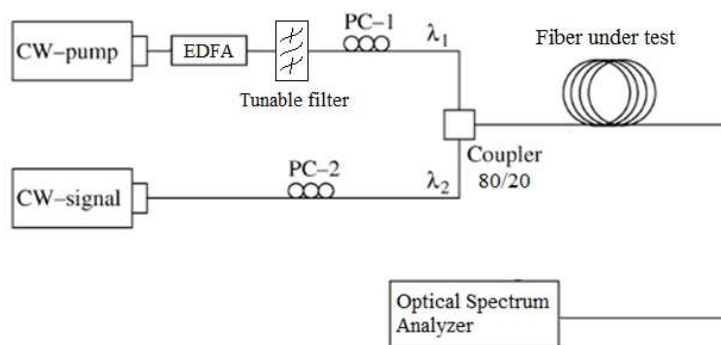


Figure 1: Measurement scheme for optical fiber γ parameter measurement using FWM.

REFERENCES

1. Hecht, J., "Recycled fiber optics, how old ideas drove new technology," *Optics and Photonics News*, Vol. 23, No. 2, 22–29, 2012.