

CP.22

**ESTIMATION OF ERBIUM DOPED OPTICAL
FIBER NONLINEAR COEFFICIENT**

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Attenuation in telecommunications optical fiber is typically low. Nevertheless optical signal amplification is required especially in backbone networks because of long transmission distances (more than 40 km) and high data transmission speeds (more than 10Gbps). For wavelength division multiplexing (WDM) technology the preference is given to the erbium-doped optical fiber amplifiers (EDFAs). EDFA working principle is based on optical signal amplification using stimulated emission in the fibers with a small controlled amount of erbium added to SiO₂ in the form of Er³⁺ ion. Erbium doped fibers (EDF) typically have smaller core size than standard ITU-T G.652 fiber to achieve single mode propagation at both: pump wavelength at 980nm and amplification range from 1525 to 1565 nm. Because of smaller core size optical radiation intensity in such a fiber is higher and can cause nonlinear optical effects (NOE) appearance.

Purpose of this research is to evaluate EDF nonlinear characteristics and determine its nonlinear coefficient using picosecond laser pulses with pulse energy 0.6 – 1mJ.

Measurement setup (Fig.1.) consists of picosecond laser spectrometer, fiber under test and spectrum analyzer and power meter. Picosecond laser spectrometer generates short optical pulses with a high maximum intensity. Pulse width is 15-35 picoseconds. Fiber under test is 10 meters long EDF. Test fiber length is chosen accordingly to typical EDF length in amplifiers. Initial measurements have been done with a power meter and spectrum analyzer connected directly to laser source output to determine optical signal power and spectral properties. After that fiber under test was inserted between source and measurement equipment. From measurement results it is possible to calculate optical fiber nonlinear characteristics in the form of nonlinear coefficient.

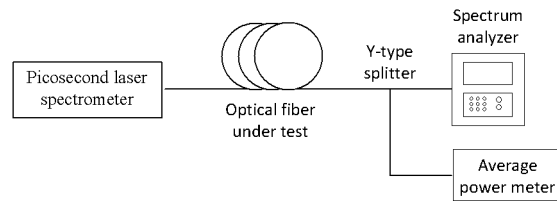


Fig.1. Experimental measurement scheme

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 $2.4 \cdot 10^{-10} - 3.5 \cdot 10^{-10} \text{ 1/W}$, whereas n_2 – in the range $1.2 \cdot 10^{-20} - 1.75 \cdot 10^{-20} \text{ m}^2/\text{W}$ depending on the optical pulse width. Results accuracy was calculated to be in the range of 5%.

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