MULTIPLEXER FOR ATTENUATION MEASUREMENTS DURING POF DURABILIY TESTING

Bernd Günther, **Wolf Czepluch, Klaus Mäder, Steffen Zedler**

Federal Institute for Materials Research and Testing (BAM)
Berlin, Germany

ABSTRACT: An optical multiplexer has been developed for attenuation measurements during POF durability testing. The attenuation measurements are performed at the wavelengths 525 nm, 590 nm and 650 nm. This paper discusses the design and performance of the multiplexer.

INTRODUCTION

One tool proven for testing POF reliability and life time is measuring their transmission during accelerated ageing at different temperatures and high humidity in a climatic chamber (fig. 1). To improve and compare their testing facilities, four companies and institutes agreed in a joint project for testing various POFs under different climatic conditions. The test results are reported in this conference proceedings separately.

This paper describes a special multiplexer (fig. 2) constructed for these experiments, which allows repeated transmission measurement of all POFs at given time intervals and at given wavelengths.

MULTIPLEXER DESIGN

The multiplexer ideal for this purpose should fulfil the following requirements:

- "turn key-system" without need for maintenance during the expected time of the experiments (up to half a year)
- installation outside the climatic chamber used for stressing the POFs
- quasi simultaneous transmission measurements of up to 20 stressed fibres
- quasi simultaneous transmission measurements at three different wavelengths: 525 nm, 590 nm and 650 nm with high efficiency and accuracy
- measurement uncertainty < 1%
- well-known transmission of light by monitoring a reference fibre.

Commercially available multiplexers are based mainly on splitting the light in different branches of switches and couplers. For about 20 POFs the necessary hierarchy of switches would result in a very low light signal for each port. Therefore a special multiplexer was developed according to the details given in fig. 3.

Wavelength separation is performed by using one of three internal LEDs or an external light-source via a 4 x 1 coupler in connection with a mechanical shutter. The generated light is guided into the POF-samples under test and a non stressed reference POF, chosen one by one by means of a linear positioning stage acting as a mechanically operating sample exchanger. This principle avoids splitting the light between the tested POFs.

The attenuated light leaving the samples can be registered either by a photodiode or an external spectrometer. The data are transferred directly to a PC. The time needed for one measuring cycle with 20 samples and 3 wavelengths is about 2 minutes, a negligible time span compared to the slow changes of the POF transmission during accelerated ageing.

Fig. 1: Climatic chamber with PC-controlled multiplexer

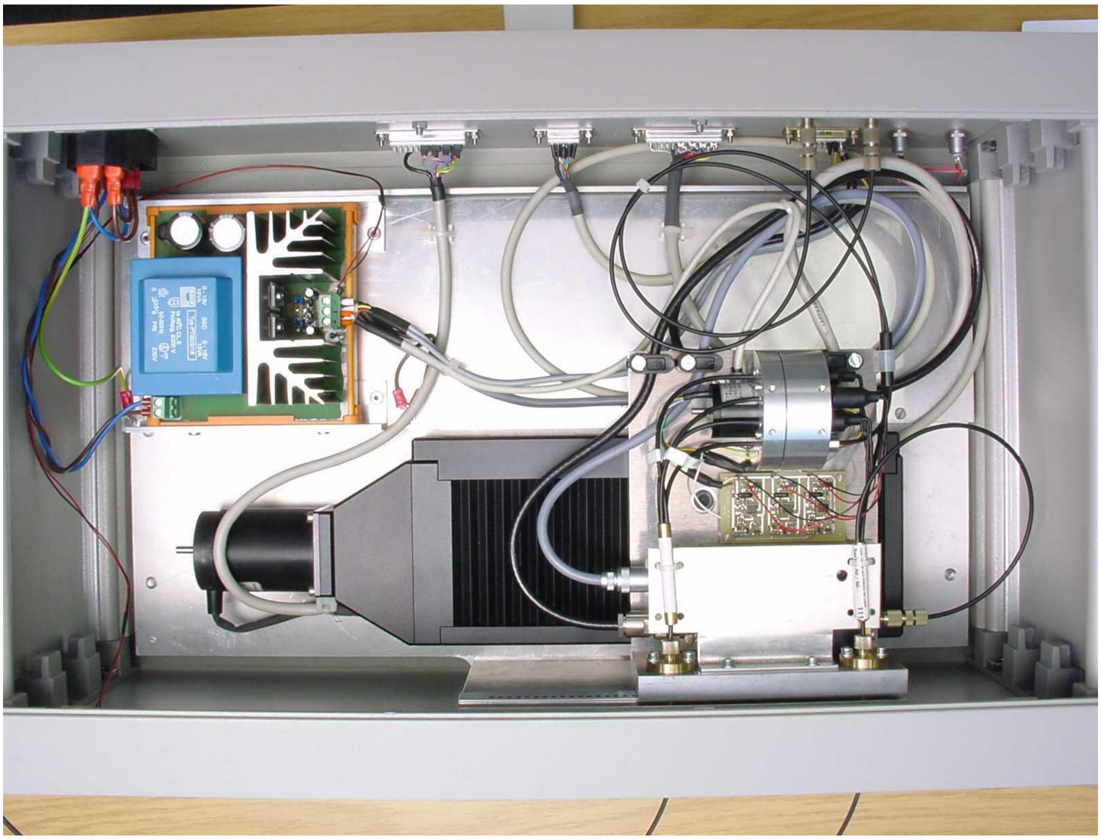

Fig. 2: Top view of the multiplexer

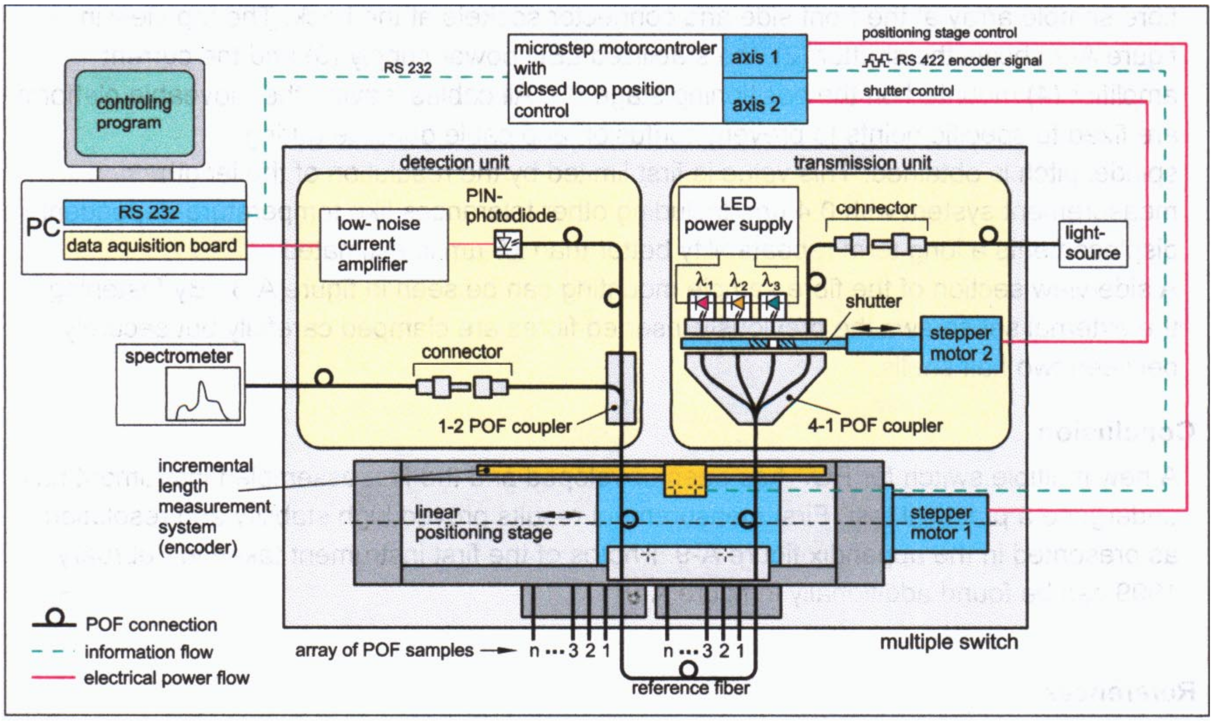

Fig.3 : Principal design of the multiplexer

Measurement uncertainty

One important aspect of the measurement uncertainty introduced by the multiplexer itself is its stability in respect to its optical transmission. The information could be delivered by a reference signal generated by an unstressed fibre. Taking this as a correction signal, the measurement uncertainty introduced by the multiplexer could be reduced remarkably.

Expected advantages with respect to stressed POFs are:

- reducing systematic errors in long time transmission measurements,
- monitoring of slow transmission changes,
- improving the accuracy of the 50% transmission as fail/pass criterion.

As a check a one-month-test was performed with several fibres under experimental conditions comparable to the project for the - climatically not stressed - reference fibre (laboratory conditions).

According to fig. 4 as a typical result, time depending transmission variations occurred:

- at the start probably due to mechanical settling,
- at an accidental mechanical displacement on day 23,
- in a daily cycle with temperature and/or brightness changes of the environment,
- on long-time basis, e.g. due to property changes of the LEDs and the detector.

Wavelength depending transmission variations occurred:

- due to the used LEDs combined with the absolute signal level available.

Correcting these data with the ones of the reference measurement resulted in remarkable improvements (fig. 5 and fig. 6).

Conclusions:

Simultaneous measurement of a reference fibre

- can reduce transmission uncertainties from 5% to 0.5%,

- is most effective at 650 nm (according to fig. 6),
- does not require the same length of reference and sample fibre,
- allows long term transmission measurements with high resolution and accuracy,
- improves the determination of small property changes of stressed POFs.

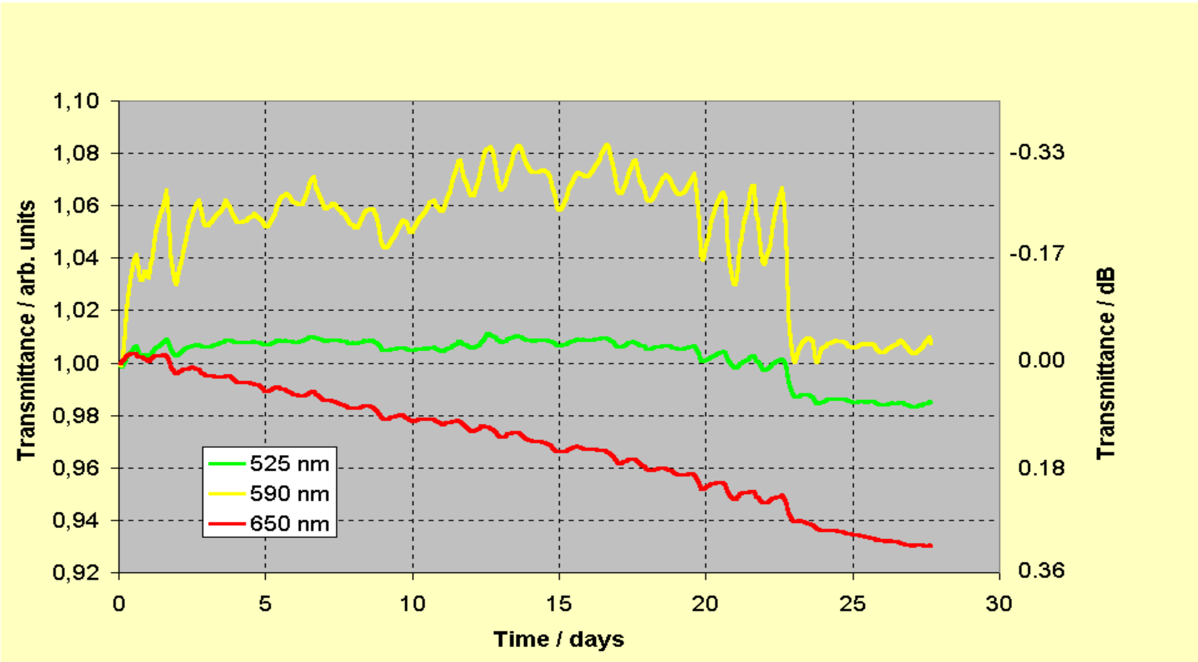

Fig. 4: Time dependence of the multiplexer with a 10 m POF-sample without correction

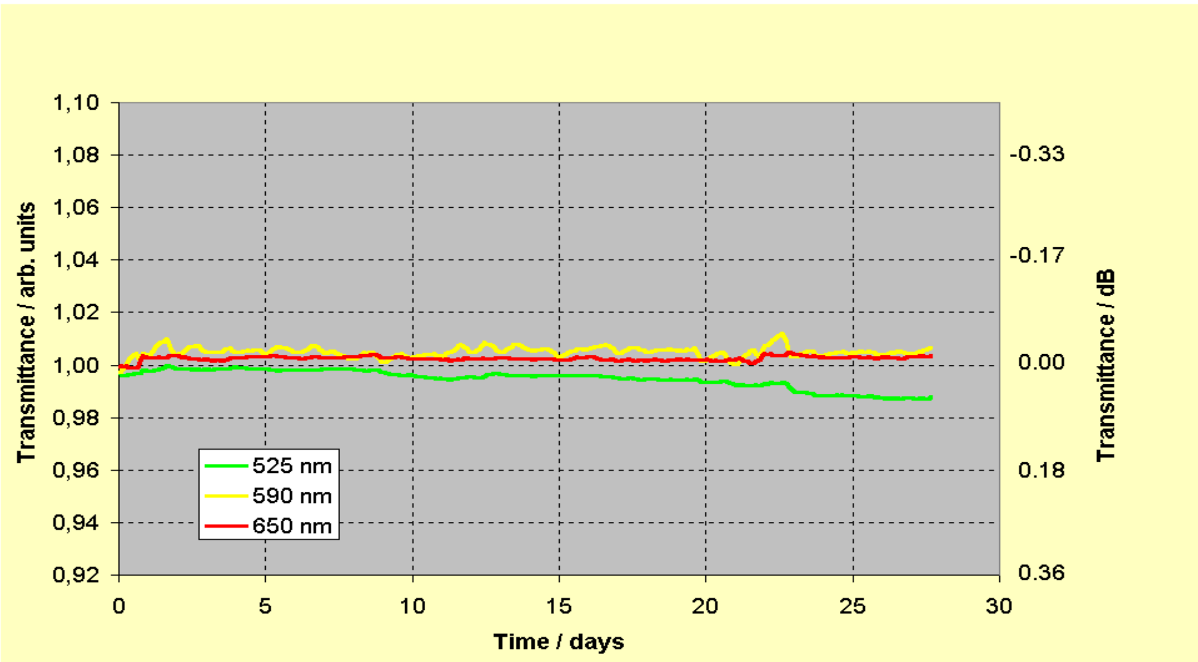

Fig. 5: Time dependence of the multiplexer with a 10 m POF-sample, with correction by a 0.2 m POF-reference

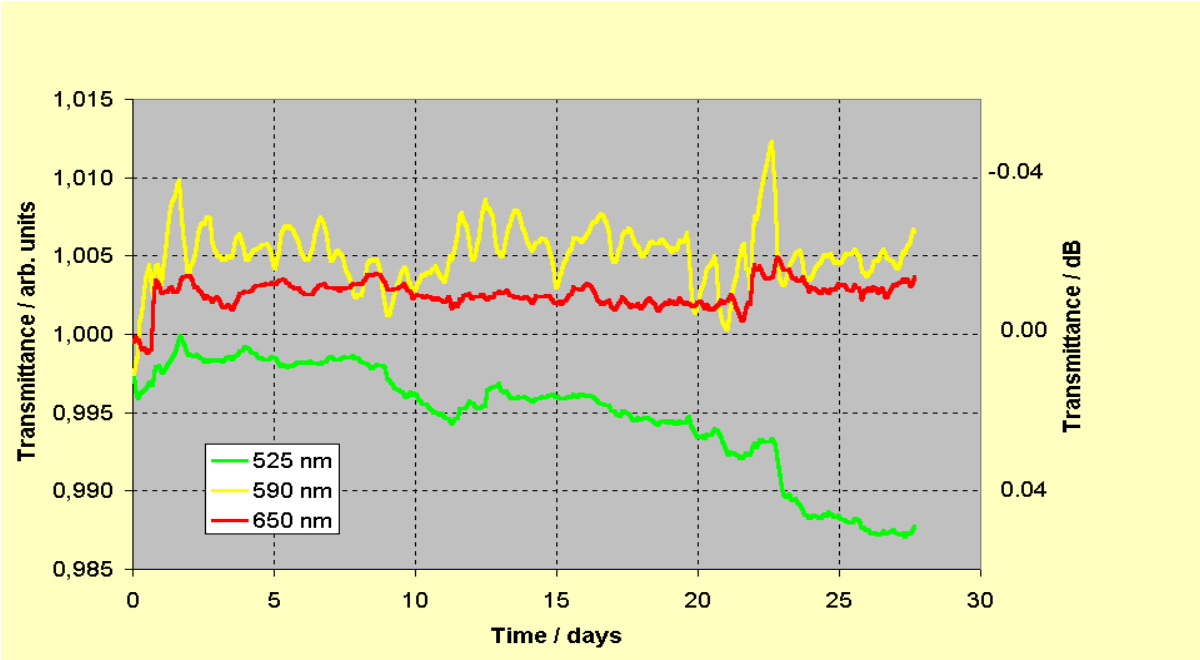

Fig. 6: Time dependence of the multiplexer with a 10 m POF-sample, with correction by a 0.2 m POF-reference (extended scale of the ordinate!)

CONTACTADDRESS:
Bernd Günther,
Federal Institute for Materials Research and Testing (BAM),
Unter den Eichen 87,
D-12205 Berlin, Germany,
e-mail: bernd.guenther@bam.de,
Phone: +49-30-8104 3577,
Fax: +49-30-8104 3047