Verification of the linearity of an optical filter kit using the Cary 5000 UV-Vis-NIR spectrophotometer

Technical Overview

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Introduction

An optical manufacturer[1] provided a high absorbance linearity filter set. This filter set consists of seven Schott Neutral Glass (NG1) filters of increasing absorbance and a blank. The thicknesses of these filters have been varied to give absorbances increasing linearly to an absorbance greater than 8 at 546 nm, and to maintain spectral characteristics over a wide wavelength range. To verify the linearity of filters such as these, a spectrophotometer capable of maintaining excellent photometric linearity at very high absorbance values, over a wide dynamic range must be used. Photometric linearity determines how accurately an instrument measures absorbance with increasing concentration. The dynamic range of an instrument is the region over which the absorbance and concentration remain directly proportional to one another. Photometric linearity becomes increasingly important at high optical densities where light flux on the detectors is low.

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This paper will verify the linearity of the filter kit in the UV-Visible region using a Cary 5000 UV-Vis-NIR spectrophotometer.

Materials

- Cary 5000 UV-Vis-NIR spectrophotometer
- High absorbance linearity filter set[1]
- Neutral density filter kit
- Linear Neutral Density filter kit

Discussion

Spectra of the filters made of Schott Neutral Glass (NG1) can be seen in Figure 1. All filters exhibit the same spectral profile irrespective of the filter thickness. The spectra were recorded using a Cary 5000 UV-Vis-NIR spectrophotometer. The measurements were made with a spectral bandwidth of 5 nm, signal averaging time of 1 s, in 'double beam' mode using full slit height. Baseline correction (Zero/Baseline Correction) was used. UV-Vis Neutral Density filters were used to provide rear beam attenuation.

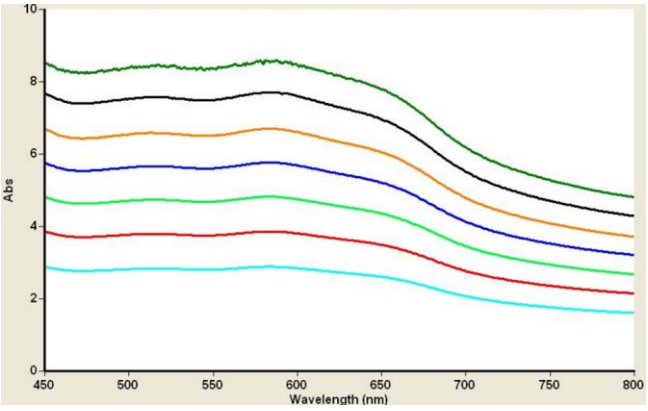

Figure 1. Plot of Absorbance versus wavelength of the filter kit

The plot of absorbance at 546 nm versus nominal filter thickness (Figure 2) highlights the linear characteristics of the filter set. A linear regression was performed on the data and a coefficient of determination (R^2) of 0.99995 was obtained indicating an excellent fit.

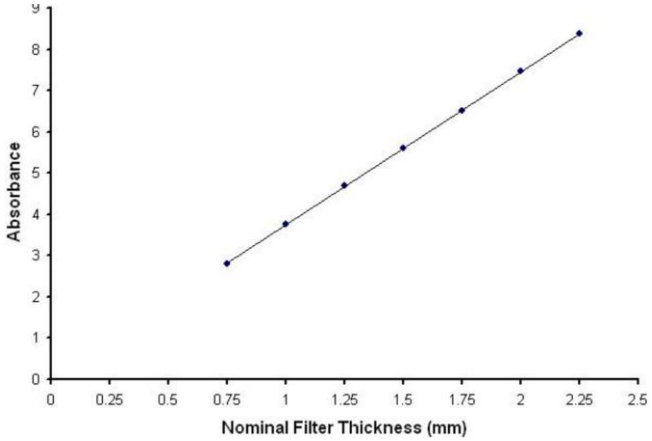

Figure 2. Plot of Absorbance at 546 nm versus filter thickness

Summary

The linearity of the filter kit was confirmed using data collected on a Cary 5000 UV-Vis-NIR spectrophotometer. Due to the high absorbance range of the filter kit such data can only be collected on an instrument with excellent photometric linearity, wide dynamic range and low stray light levels, such as the Cary 4000/5000/6000i UV-Vis-NIR spectrophotometers.

Ordering information

Description	Part number
Cary 5000 UV-Vis-NIR spectrophotometer	0010079300
UV-Vis Neutral Density and Blue Attenuator filter kit	9910047700
Neutral Density filter kit	0218006500
Linear Neutral Density filter kit	9910056100

References

1. Hellma GmbH & Co KG,Klosterrunsstrasse 5, D-79371 Müllheim. (Reference Number 666.034)

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