

Linearity Measurements in the Visible Region on a LAMBDA 850/950/1050 Using Hellma Linearity Filters

UV/Vis/NIR Spectroscopy

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Introduction

This note demonstrates the use of Hellma® linearity filters to study the linearity of the PerkinElmer® high performance LAMBDA™ instruments (LAMBDA 850, 950 and 1050) in the visible region of the spectrum. Hellma® linearity filters are cut from the single block of “black” glass with increasing thickness, and polished to high tolerances, so that the thicknesses increase in equal steps. The glass is selected so that the steps in thickness of the filters (0.25 mm) result in approximately 1 Å change in absorbance at 546 nm. Although the steps may not be exactly 1 Å, the size of the increase in absorbance should be equal.

Experimental

Wavelength scans are taken on a LAMBDA 950 between 400-700 nm in 2 nm steps, with a slit width of 5 nm and a detector response time of 1 second. When required, signal to noise was optimized by attenuating the reference beam with internal attenuators. The LAMBDA 950 has 1 Å and 2 Å auto-attenuators which may be augmented by an additional magnetic attenuator on the sample compartment window as necessary. The LAMBDA 1050 features automatic 2 Å and 3 Å attenuation and can be similarly augmented. For all spectra, 100% and 0% autozero correction scans were taken.

Results

The spectral data collected are displayed in Figure 1. There is no significant noise apparent on the data even for samples with absorbance greater than 8Å.

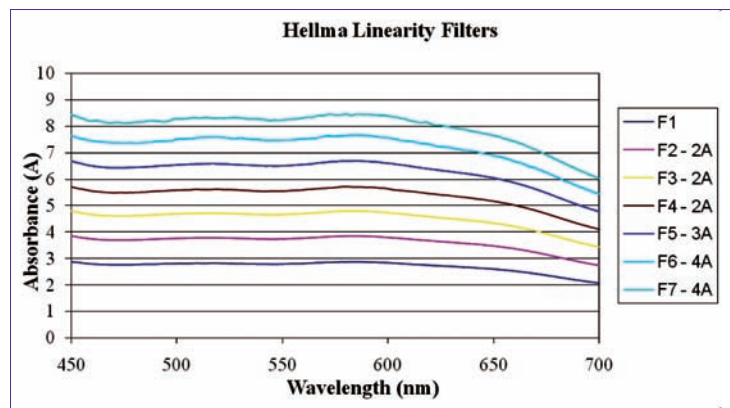


Figure 1. Scan taken with Hellma® filters (F1-F7 – See Table 1) between 400 and 700 nm with 2 nm steps, 5 nm slit and 1 second integration time. The attenuation used in the reference beam is shown alongside the filter number.

Table 1. Hellma® filters used.

Filter number	Absorbance approx.	Thickness
666.034/1-F1	3 A	0.75 ±0.01 mm
666.034/1-F2	4 A	1.00 ±0.01 mm
666.034/1-F3	5 A	1.25 ±0.01 mm
666.034/1-F4	6 A	1.50 ±0.01 mm
666.034/1-F5	7 A	1.75 ±0.01 mm
666.034/1-F6	8 A	2.00 ±0.01 mm
666.034/1-F7	9 A	2.25 ±0.01 mm
666.034-F0	–	Blank

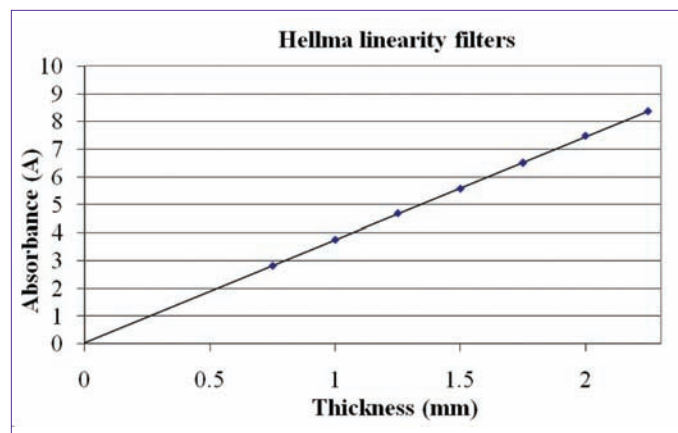


Figure 2. Measured absorbance of Hellma® filters against filter thickness.

Conclusion

High quality spectral data have been obtained for samples greater than 8 A. The absorbance linearity of the data is very good with only small deviation from the linear fit >0.04 A, and these errors can be attributed to the thickness tolerance of the Hellma® linearity filters.

These results were taken with a LAMBDA 950 spectrometer, but equivalent results can be obtained with all instruments in the LAMBDA 850/950/1050 series. The LAMBDA 1050 provides enhanced functionality for high absorbance samples due to its higher light throughput (source doubling mirror) and built-in automated attenuators up to 3 A (LAMBDA 950 up to 2 A). The LAMBDA 1050 can measure samples with attenuation values approaching 8 A without use of additional manual attenuators.