Upgrade your spectrophotometer from absorbance to sample quantification and kinetics study with NanoCuvette™ One

Introduction

avantor™

Before we begin

We will send you the recording

Submit your questions anytime. We'll do Q&A in the end

Contact us: webinar@avantorsciences.com

The speakers

Emil Højlund-Nielsen - CEO, PhD
Copenhagen Nanosystems

Sangita Khatri - Research Scientist
Copenhagen Nanosystems

WEBINAR 2021

avantor™ delivered by VWR™

UPGRADE YOUR SPECTROPHOTOMETER

Upgrade your spectrophotometer from absorbance to sample quantification and kinetics study with NanoCuvette™ One

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OUTLINE

- About the company
- Absorption spectroscopy (Beer-Lambert law)
- VWR Collection spectrophotometers
- Introducing label-free spectroscopy
- NanoCuvette™ One
- SpectroWorks™
- Conclusion

Sangita Khatri
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Poll Question 1

Do you have a cuvette-based UV-Vis spectrophotometer in your lab?

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- VWR Collection spectrophotometers
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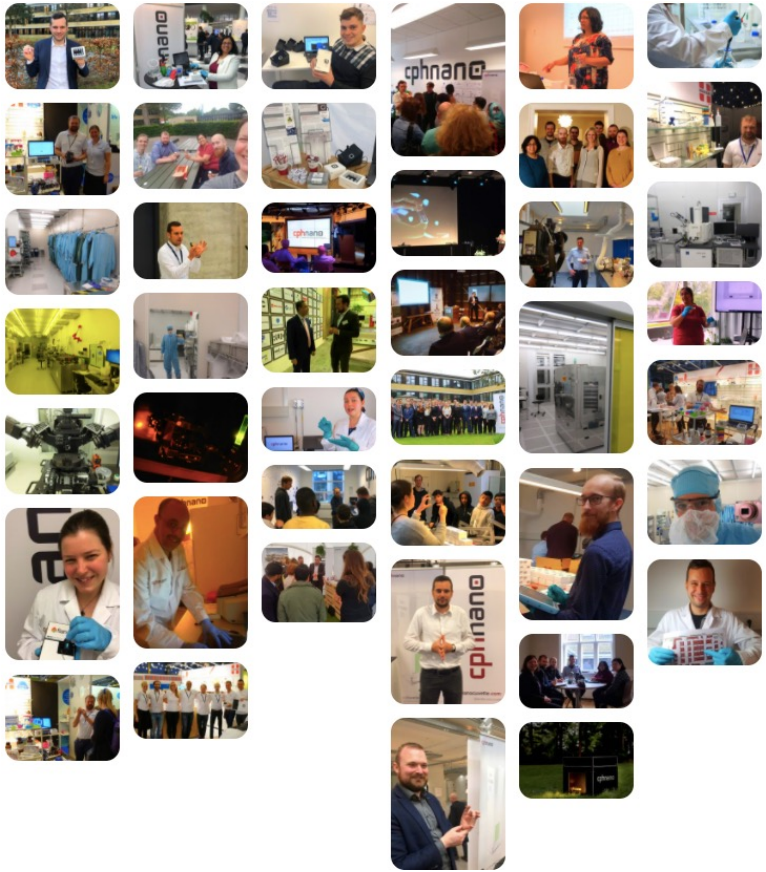
cphnano

ABOUT THE COMPANY

- **Founded in 2015, cphnano is a Danish labtech company** from Copenhagen that develops digital laboratory analysis and diagnostics for the smart lab of the future. We believe that laboratory analysis should be a simple and accessible global commodity for everyone.
- **We work with upgrading UV-Vis spectrophotometry** across all brands to be at the forefront at the technology development for the Smart Lab of the Future and Industry 4.0, including optical modelling in the cloud for better chemical and biological analysis, IoT connectivity and ground-breaking nanotechnology for life science applications.
- **We sell consumables and digital upgrades** for laboratory equipment through our trusted resellers and partners. Our offerings only require a conventional spectrophotometer which is found in labs across the globe. Thereby, our customers can enjoy an integrated, seamless digital experience around spectrophotometry available in more than 20 countries.



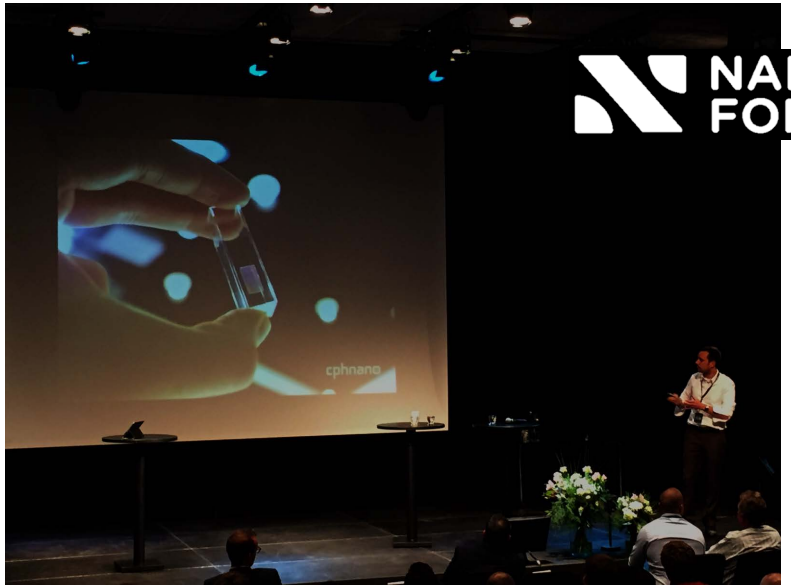
CPHNANO AWARDS, PRICES & RECOGNITIONS

2016: Danish Tech Challenge

2017: Nordic company of the year - 2nd place

2019: Eureka label

2020: DTM tech exhibition



CPHNANO PRODUCTS

Get your standard pack of 10 cuvettes by ordering via **vwr.com** with number:

ECN: 634-1176

CUVETTE BH15/20-REFRAC. INDEX ABSORB.

avantor™ delivered by VWR™
VWR.COM

NanoCuvette™ One (10 pcs)

- Commodity
- Dual system for label-free and absorbance data
- 8.5 mm and 15/20 mm versions
- Including SpectroWorks™ full functionality and free support

SpectroWorks™

- Online software for spectrophotometry
- Included with Nanocuvette™ One purchase
- Drag and drop easy
- All future updates included

Upcoming:

- NanoCuvette™ S (particle sizes)
- SpectroLink™ (IoT connection)

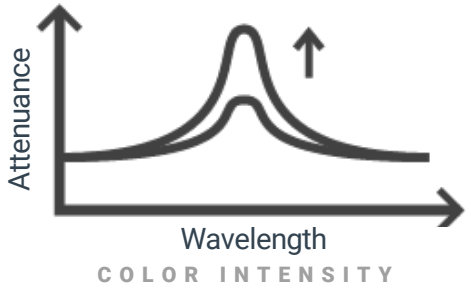
MADE IN DENMARK

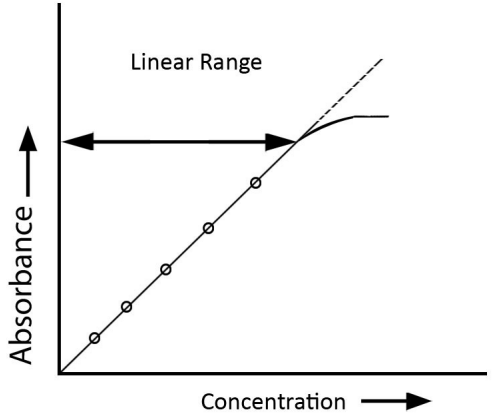
ABSORPTION SPECTROSCOPY AND BEER LAMBERT LAW

The Beer-Lambert law relates the attenuation of light to the properties of the material through which the light is travelling:

$$A = \varepsilon c l + A_0$$

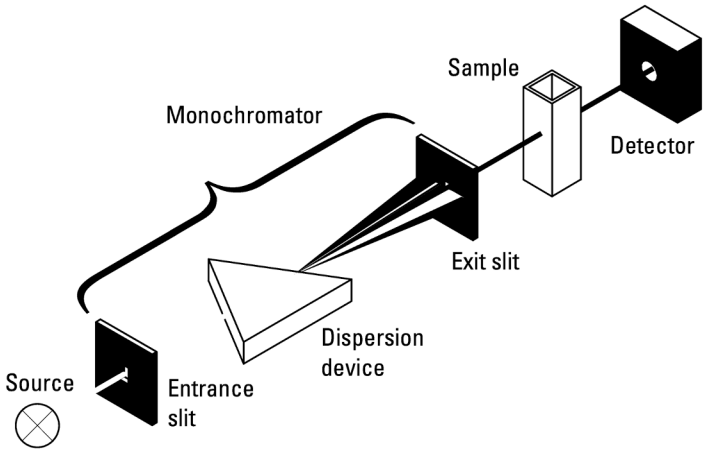
where A is the absorbance, ε is molar extinction coefficient, c is the concentration, l is the path length and A_0 is the background absorbance.





THE SPECTROPHOTOMETER

- Spectrophotometry is one of the most widely used analytical procedures in many labs.
- It is used to estimate the level of a substance in a solution and is ideal for simple routine determination of small quantities of materials such as DNA, RNA, proteins, enzymes and many other substances.



Beckman DU spectrophotometer 1942

Vitamin A Analysis

Before the Beckman DU, the assay to test for the concentration of Vitamin A in supplements involved:

1. Feed rats a diet rich or poor in your supplement for 3 weeks
2. Measure the length of tail growth
3. Correlate amount of bone growth to Vitamin A concentration

After the Beckman DU, the assay to test for the concentration of Vitamin A in supplements was:

1. Dissolve supplement in water
2. Measure absorption spectra on Beckman DU.

Nucleic Acid Analysis

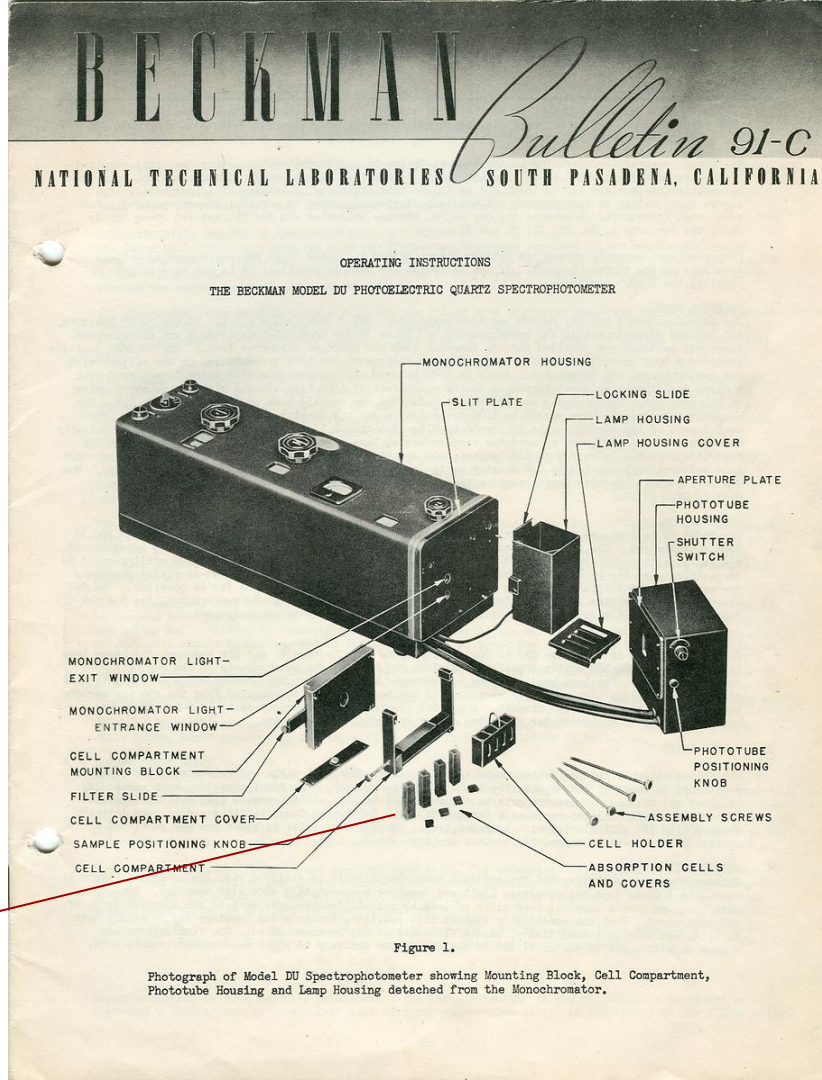
Using a Beckman DU, Edwin Chargaff conducted experiments that discovered the adsorption spectrum of the four DNA amino acids. This discovery led to the base pair theory of DNA assembly, which was essential to later solve the double-helix structure of DNA.

Rubber analysis with Beckman IR spectrophotometer

During WWII, the US natural rubber supply was cut-off. By 1942, Beckman Model IR-1s were used at all synthetic rubber factories to analyze constituent materials during manufacture.

Morgareidge, K. "Influence of the Solvent on the Ultraviolet Absorption Maximum of Vitamin A". Industrial and Engineering Chemistry, 14, pp 700-702 (1942).

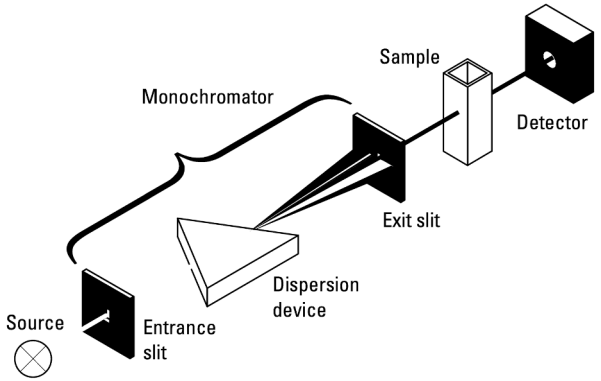
Chargaff, E. "The Separation and Quantitative Estimation of Purines and Pyrimidines In Minute Amounts" J. Biol. Chem. 176, 703-714 (1948).



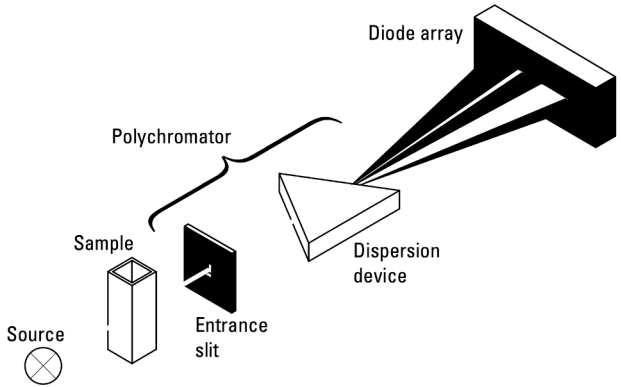
Cuvettes

SPECTROPHOTOMETER BASICS: INSTRUMENT TYPES

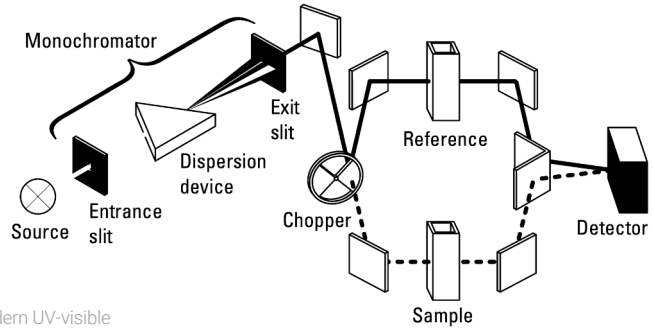
Conventional scanning spectrophotometer



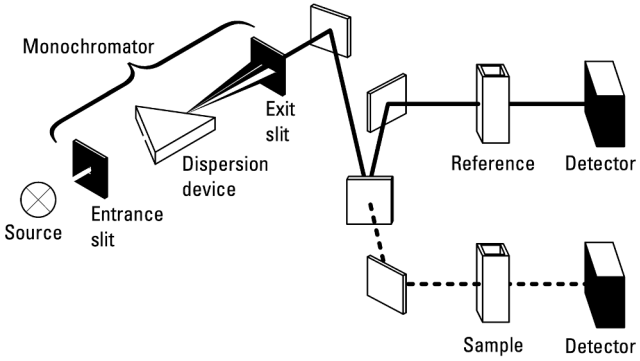
Diode array spectrophotometer



Scanning dual-beam spectrophotometer



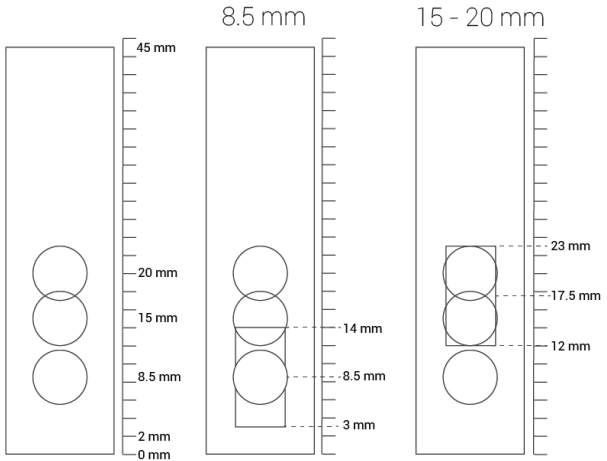
Scanning split-beam spectrophotometer

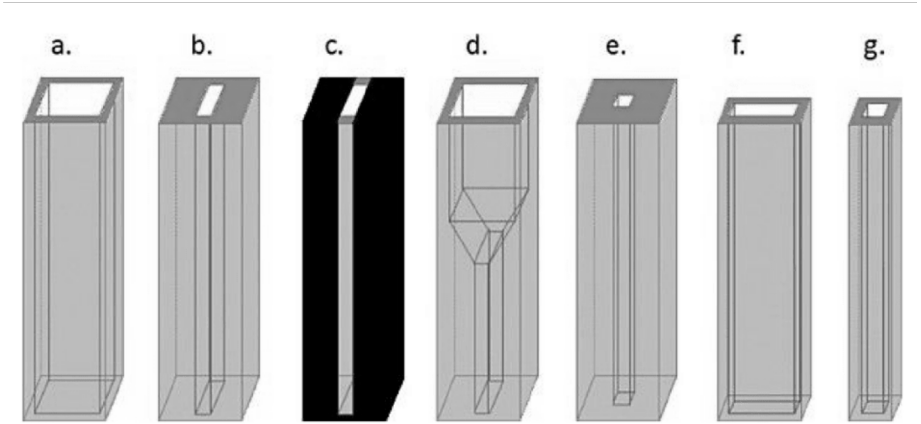


Source: Fundamentals of modern UV-visible spectroscopy, Agilent Technologies.

SPECTROPHOTOMETER BASICS: CUVETTES AND BEAM HEIGHTS

- Glass, Quartz and plastic materials
- 8.5 mm, 15 mm and 20 mm
- 1/10 cm standard path length





a) 10 x 10 mm inner size fluorescence cuvette.
b) 2 x 10 mm semi micro fluorescence cuvette.
c) 2 x 10 mm semi micro absorption cuvette.
d) 2 x 10 mm sub micro volume cuvette.
e) 2 x 2 mm inner size fluorescence cuvette.

Image: https://23areu3fx33q49lg9k24w5ve-wpengine.netdna-ssl.com/wp-content/uploads/2020/07/Different-Cuvettes-Schematics.png

Poll Question 2

If you have a UV-Vis spectrophotometer, which brand is it?

cphnano

VWR SPECTROPHOTOMETER COLLECTION LINE-UP

vwr™ part of avantor







Model	V-1200	UV1600-PC	3100-PC	6300-PC	M4	P4	PV4
Type	Scanning	Scanning	Scanning	Scanning	Scanning	Scanning	Scanning
Wavelengths (nm)	325-1000	190-1100	190-1100	190-1100	190-1100	190-1100	190-1100
Beam height (mm)	15	15	15	15	15	15	15
Minimum spectral band width (nm)	4	4	2.0	1	2.0	2.0	2.0
Wavelength accuracy (nm)	2.0	0.5	0.5	0.3	0.5	0.5	0.5
Max scanning speed (nm/min)	4200	4200	3000	3000		4200	4200
Connectivity interface	USB	USB	USB	USB	USB	USB	USB
NanoCuvette™ compatible	✓	✓	✓	✓	✓	✓	✓

V-1200 / UV-1600PC
The V-1200 and UV-1600PC are basic Visible and UV/Vis spectrophotometers for the routine daily quality control requirements, in process control and teaching laboratories

3100-PC
The 3100-PC for advanced measurements in quality control, biochemical and pharmaceutical applications.

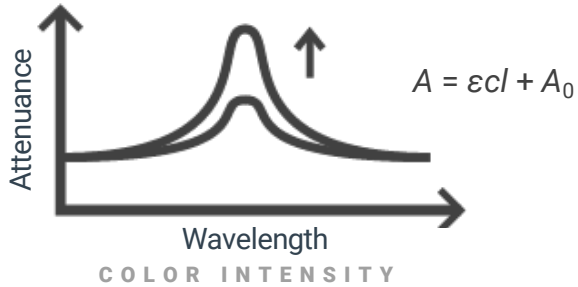
6300-PC
The 6300-PC with double-beam optical system, designed for pharmaceutical, biochemical and clinical use, new material development and quality control.

M4
The M4 single split-beam spectrophotometer, with flashing xenon lamp, is an easy to use, highly reliable and accurate product.

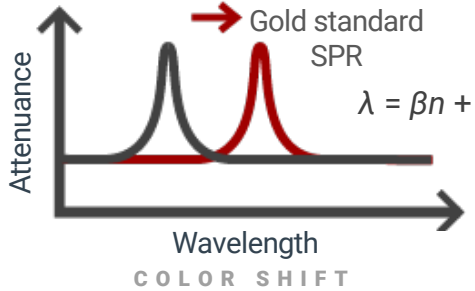
P4
The P4 UV/Visible spectrophotometer is an easy to use instrument with advanced performance

PV4
The PV4 visible spectrophotometer is an easy to use instrument with advanced performance.

INTRODUCING LABEL-FREE SPECTROSCOPY



$$A = \varepsilon c l + A_0$$



$$\lambda = \beta n + \lambda_0 = \beta(ac + n_s) + \lambda_0$$

Absorption spectroscopy (Beer-Lambert law)

Traditionally, spectrophotometers have been used to measure color intensity *on the y-axis* by absorbance or fluorescence at a fixed wavelength. With our cuvettes and software, a new type of optical filter is inserted into the light beam and the spectrophotometer now measures a wavelength color shift *on the x-axis* at fixed intensity that is proportional to the analyte concentration or sample change in the cuvette.

Label-free spectroscopy (Hands law)

The optical filter measures the refractive index, which does not require any coloration (dye or indicator) to be measured, allowing for measuring transparent solutions.

Direct label-free detection of enzymatic activity with a substrate can be monitored with the change in the intrinsic property refractive index of the solution as the product is formed over time.

Poll Question 3

Do you use a micro volume system such as Nanodrop systems?

One cuvette for dual measurements

NanoCuvette™ One

NEW LIFE FOR OLD SPECTROHOTOMETERS

Replacement 10-15 years

Refractometer

Nanodrop

PRIMARY PURCHASMENT
(Instruments)

SpectroWorks™
by cphnano

Light source

Cuttes

SECONDARY PURCHASEMENT
(Consumables)

Power supply

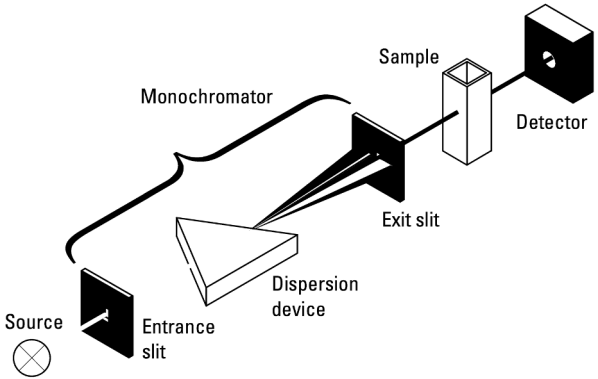
Fibers and adapters

Reagents

NanoCuvette™ One

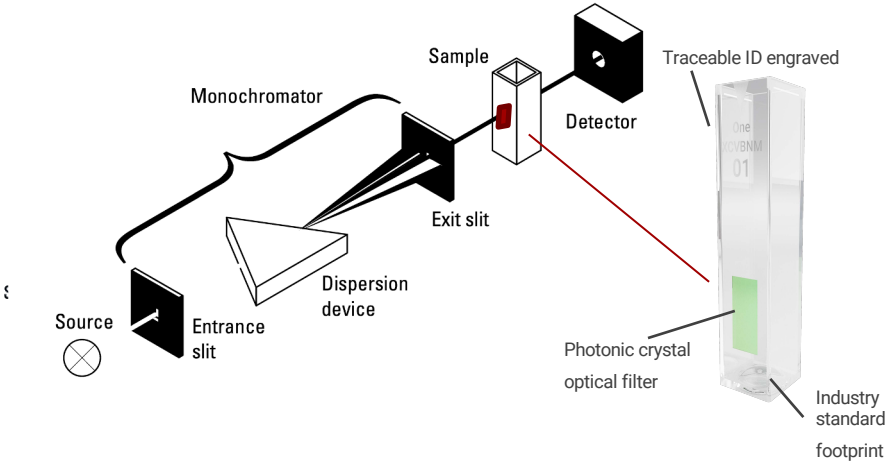
THE NANOCUVETTE UNLOCKS THE FULL POTENTIAL OF THE SPECTROPHOTOMETER

Spectrophotometry is one of the most widely used analytical procedures in biochemistry. It is used to estimate the level of a substance in a solution and is ideal for simple routine determination of small quantities of materials such as DNA, RNA, proteins, enzymes and many, many other substances.



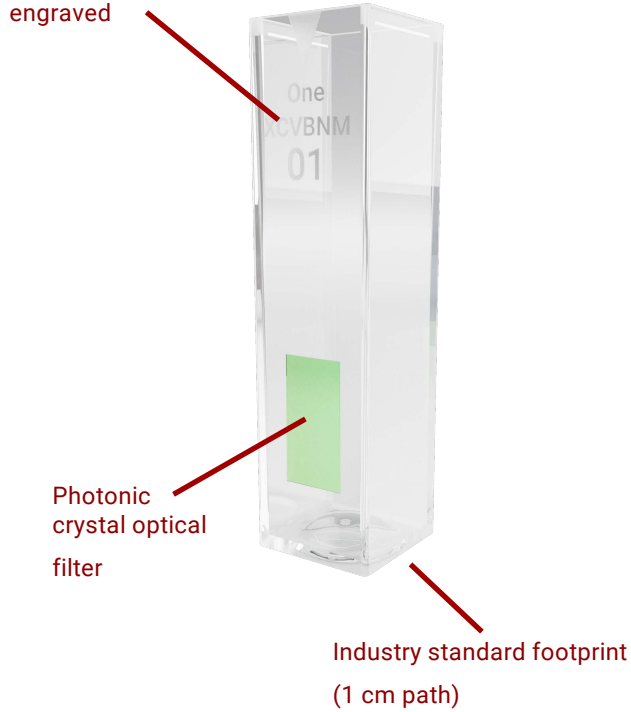
Adding an optical filter to the cuvette upgrades the analytical capability of the instrument:

- **Less sample needed for analysis** (some equipment requires sample sizes 4-6 times larger)
- **Label-free concentration measurements as well as monitoring of label-free enzymatic reactions**



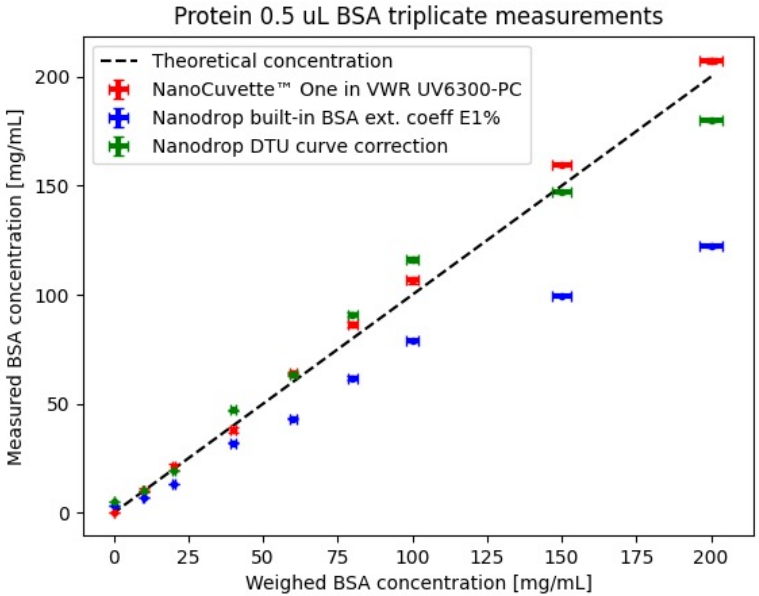
NANOCUVETTE™ ONE USE-CASES

- **Less sample needed for analysis.** Down to 0.5 µL and concentrations down to 0.2 mg/ml for sucrose (Limit of detection is below 0.2 mg/ml sucrose concentration).
- **Label-free concentration determination.**
- **Monitoring label-free enzymatic reactions.** Direct label-free detection of enzymatic activity with a substrate can be monitored as product is formed over time.
- **Replacing expensive equipment with just the spectrophotometer.**

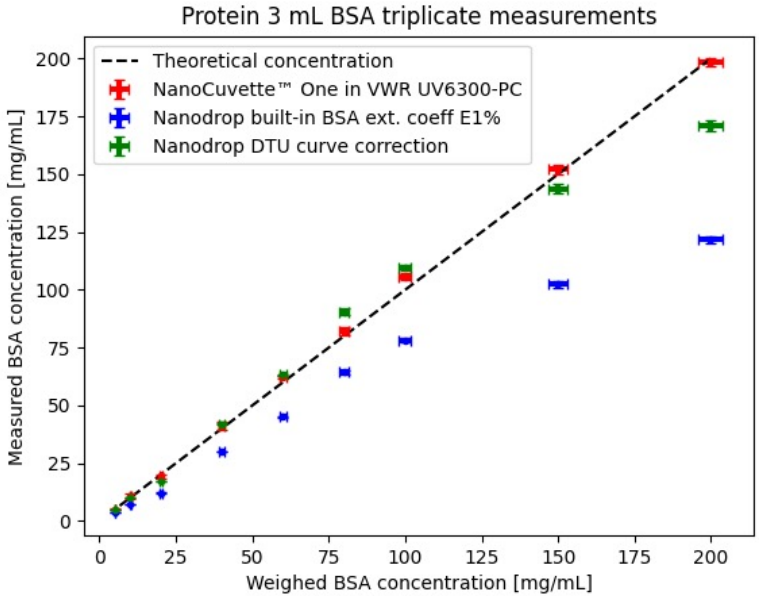


PROTEIN QUANTIFICATION I - NANOCUVETTE™ ONE COMPARED TO NANODROP 1000

0.5 uL



3 mL

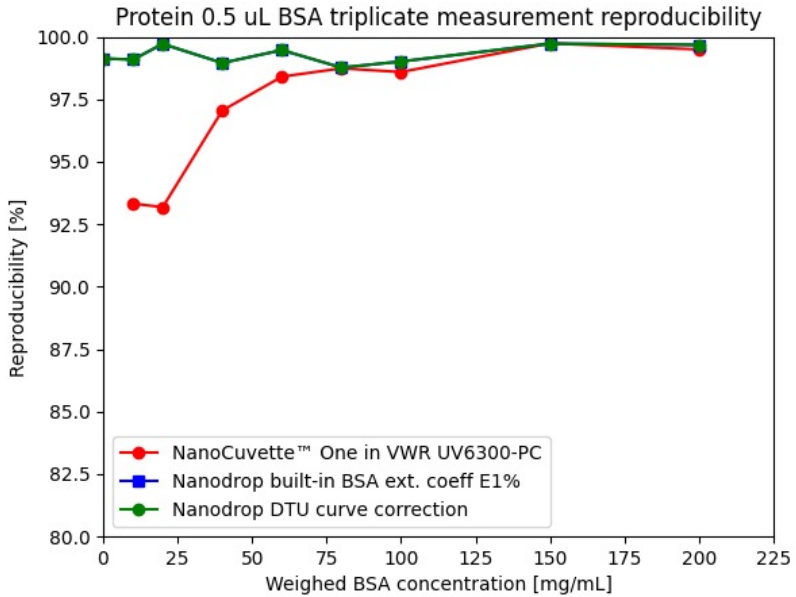


Reference measurements were done by Research Assistant Jesper Uhd at DTU chemistry using Thermo Scientific NanoDrop™ 1000.
Protein measurement was done in VWR UV 6300-PC using Nanocuvette™ One with SpectroWorks ™ 1.1 in house. Refractive increment value of 0.1650 mL/g was used in the software for BSA (data from American Polymer Standards Corporation).

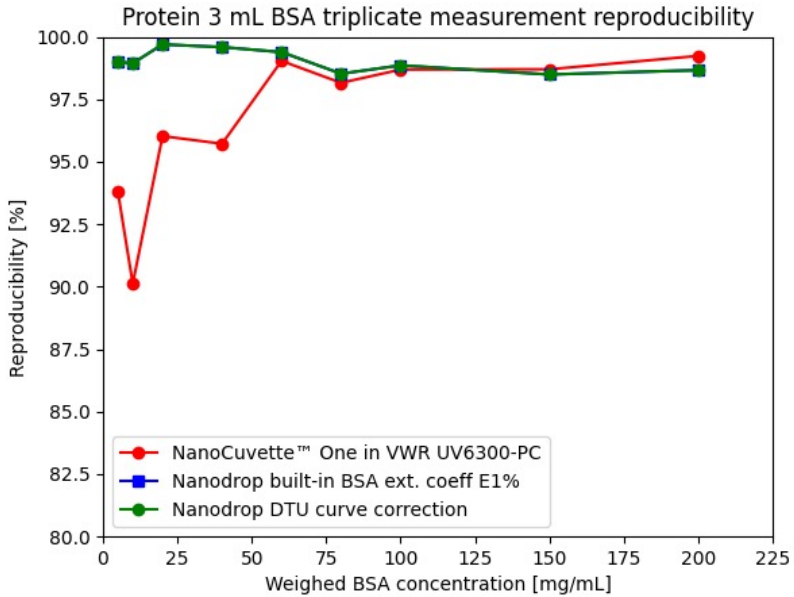
Ref.: http://www.ampolymer.com/dn-dc.html

PROTEIN QUANTIFICATION II - NANOCUVETTE™ ONE COMPARED TO NANODROP 1000

0.5 uL

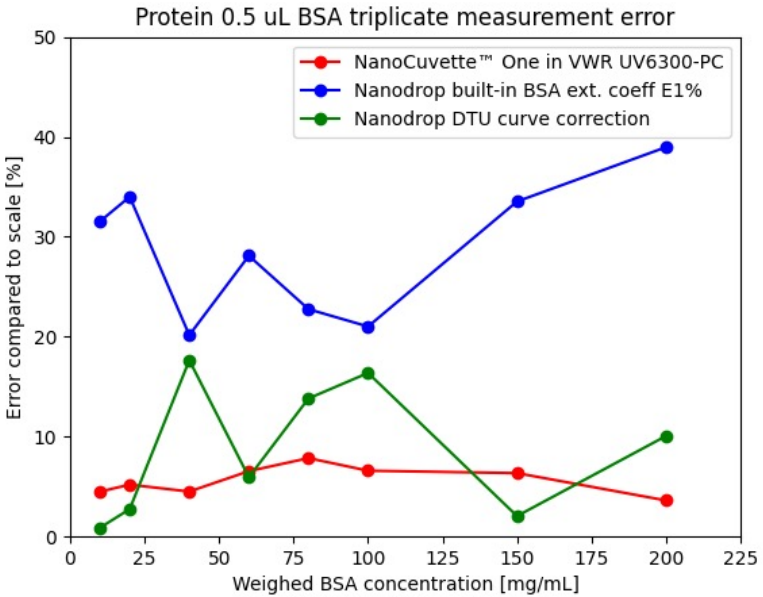


3 mL

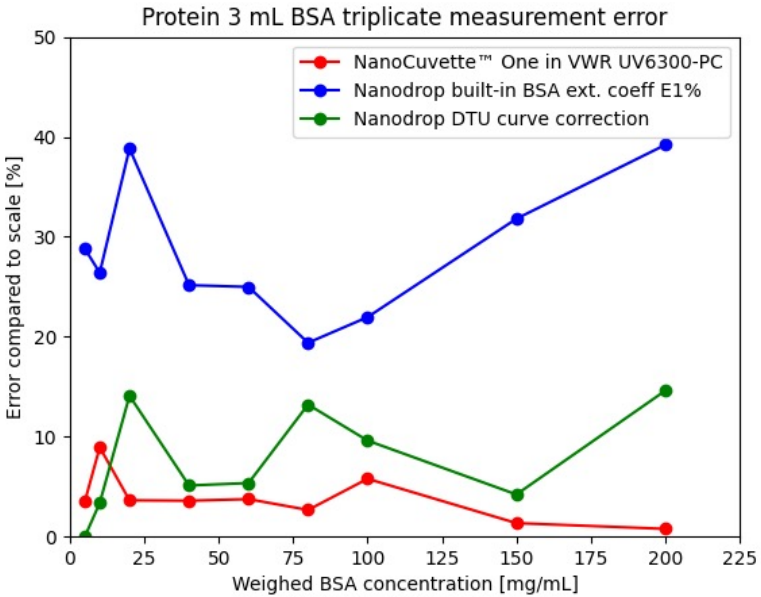


PROTEIN QUANTIFICATION III - NANOCUVETTE™ ONE COMPARED TO NANODROP 1000

0.5 uL



3 mL



NANOCUVETTE™ ONE COMPETITOR COMPARISON FOR PROTEINS

	Colorimetric assays (Bradfords, BCA, Lowry)	Qubit (Fluorescent labelling)	Spectroscopy (NanoDrop, UV/Vis spectrometer)	NanoCuvette™
Speed	Slow	Slow	Slow	Immediate
Sample volume	250 uL - 3 mL	1 - 20 uL	0.3-2 uL, 50 uL - 3 mL	0.5 uL / 3 mL
Calibration	BSA std curve	BSA std curve	None	Pre-calibrated
Accuracy	Low	Medium	Medium	High
Range	0.02 - 2 mg/mL	0.25 - 5 mg/mL	>0.06 mg/mL	>5 mg/mL
Output	Requires analysis of multiple measurements	Requires specific labels and multiple dilutions	Requires protein spectroscopic data and filtration	Cloud data analysis
Conclusion	Cheap, BUT tedious and inaccurate	Higher accuracy, BUT difficult to do	Easy to do, BUT hard to analyse	Cheap, fast and easy-to-use

NANOCUVETTE™ ONE COST COMPARISON

Cost	Colorimetric assays (Bradfords, BCA, Lowry)	Qubit (Fluorescent labelling)	Spectroscopy (NanoDrop, UV/Vis spectrometer)	NanoCuvette™
Speed	Slow	Slow	Slow	Immediate both at at-line and QC
Implementation	>200 €	>3200 €	>10.000 €	<20 €/pcs + instrument
Training required	Intermediate	High	High	Unskilled/skilled personel
Level of expertise	Graduate student	Researcher	Graduate student	High school students and up
Known issues	Innacurate results	Requires high level of expertise	Contamination issues Hard to analyze Mechanics often break	High accuracy depends on spectrophotometer optics Reuse of cuvette depends on sample type and cleaning

Upgrade your spectrophotometer with software

SpectroWorks™

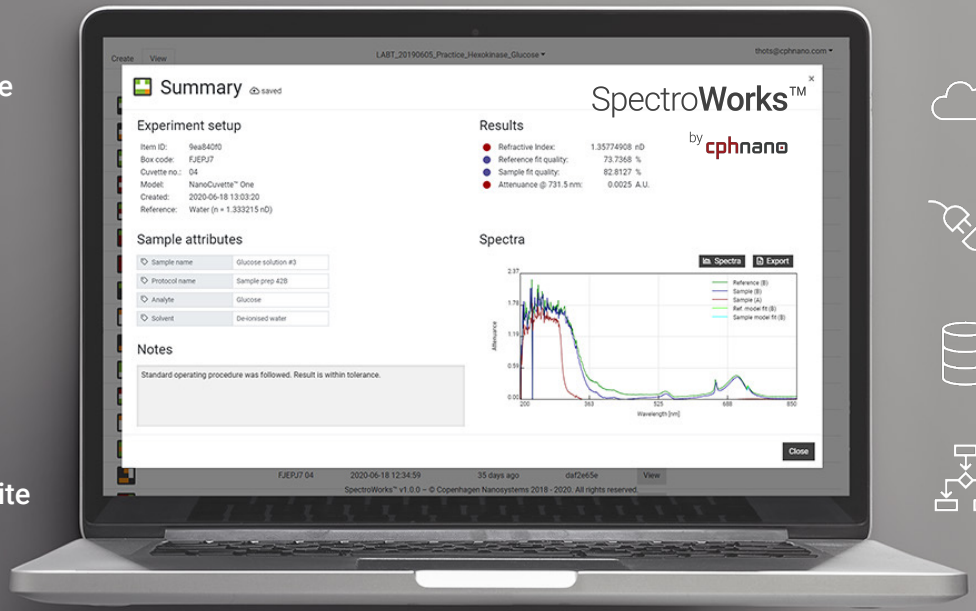
SPECTROWORKS™ MAKES SPECTROPHOTOMETRY DRAG AND DROP EASY

Collection, storage and sharing of data from spectrophotometers have historically been a tedious manual task.

SpectroWorks™ is the first online cloud service for UV-Vis spectrum analysis and automatically analyses the spectrum, corrects for optical path and cuvette misalignments by accessing 200 million calibration points, and gives back the result to the user – all in less than 5 seconds.

ADVANTAGES OF OUR DIGITAL TURN-KEY APPROACH WITH SPECTROWORKS™

- Label-free analyte measurements
- No dilutions or calibrations
- Standard equipment and methods
- Flexible with at-site operation



- Cloud-enabled software solution
- LIMS or ELN platform integration
- Secure data storage and tracking
- Quantify biological samples

WHAT'S IN IT FOR YOU?

- Realiable accurate results.
- Works with existing UV-Vis spectrophotometers in the lab.
- No download of software with always updated online software platform.
- Cuvettes can be reused - check cuvette fit quality in SpectroWorks™.
- No extensive expertise needed for operation.
- Less time wasted.
- Low cost.

BENEFITS FROM VWR COLLABORATION

- VWR/Avantor now supports reliable micro-volume measurements.
- You can order cuvettes with our lab supplies.
- Standard lab purchasement contracts can be used.
- Data sheet, technical briefs, instruction briefs and knowledge base publicly available (https://knowledge.cphnano.com/).
- Shipping across Europe.
- Shipping with new VWR Collection line instrument, so if you want to try it out, you can also order instrumnet and get free test cuvette.
- Fits into the exsting laboratory routines.

Upgrade your spectrophotometer
with NanoCuvette™ One

Conclusion

NanoCuvette™ One

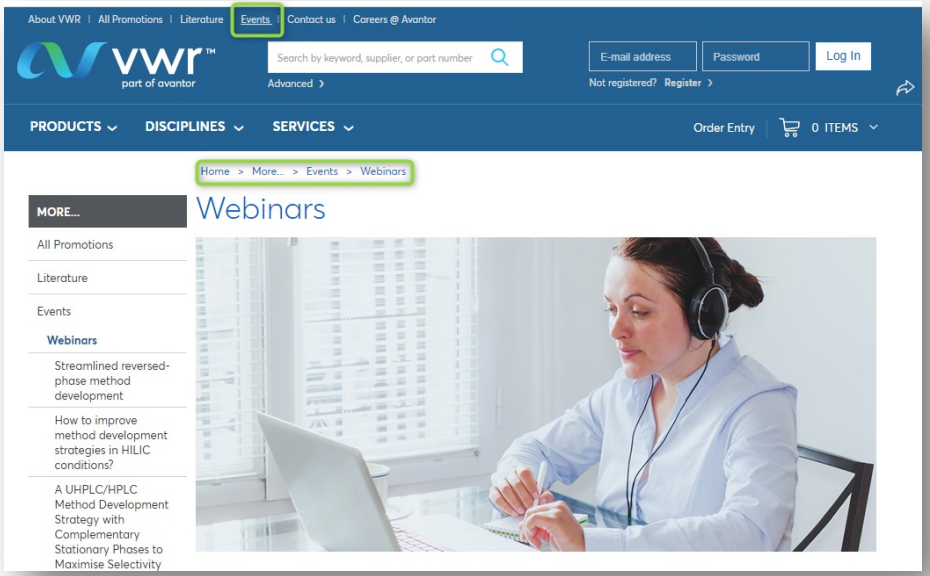
Sangita Khatri
Research Scientist
sakha@cphnano.com

Emil Højlund-Nielsen, PhD
CEO & Co-founder
emiho@cphnano.com

Upgrade your spectrophotometer

Thank you!

Conclusions



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Webinar@avantorsciences.com

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ECN: 634-1176

CUVETTE BH15/20-REFRAC. INDEX ABSORB.

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