PERFORMANCE OF A VERSATILE ABSORBANCE DETECTOR FOR MINIATURIZED AND PORTABLE LC SYSTEMS

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THE KEY features of presented versatile absorbance detector

Versatile detection capabilities **is key** to the further **development of analytical instruments**

Absorbance detectors are preferred for their **simplicity and lower complexity**

Chromatograms and absorption spectra **equivalent** to the **benchtop** DAD **detector**

Optical fiber-linked components can be **flexibly arranged** in any setup

Multichannel absorbance detection and spectra acquisition in the range 210-750 nm

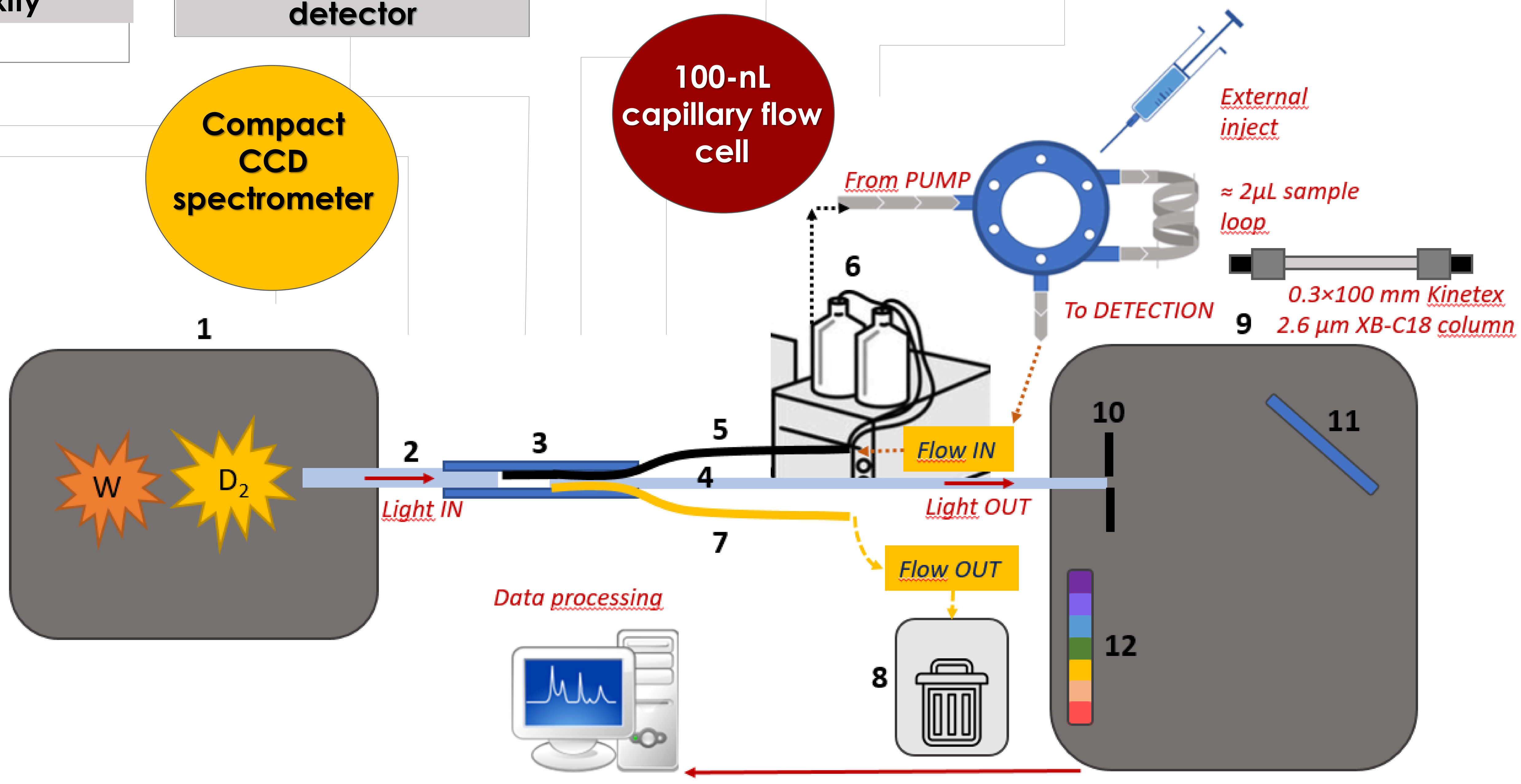


Figure:

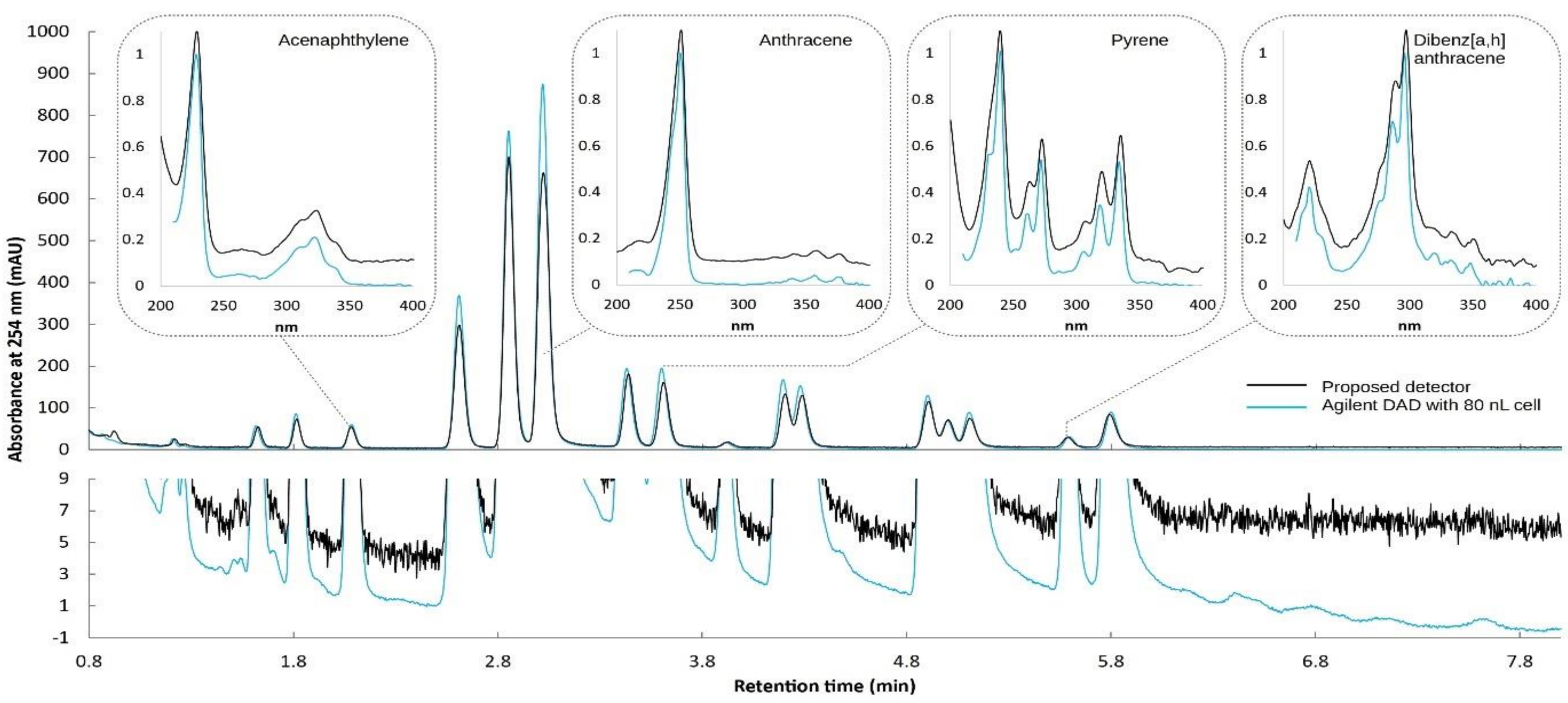
1 – Light source;
W – Tungsten lamp;
D_2 – Deuterium lamp;
2 – Light input; a 0.3 mm optical fibre;
3 – Detection area; 5.5 mm (100 nL)
4 – Light output; a 0.2 mm optical fibre;
5 – Inlet capillary;
6 – Pump;
7 – Outlet capillary;
8 – Waste;
9 – CCD detection; StellarNet BLACK- Comet CCD spectrometer
10 – Slit; 200 nm
11 – Concave holographic grating;
12 – Linear CCD array

EXPERIMENTAL PART

Table: Overview of Detector Parameters

Wavelength	210 nm	266 nm	330 nm	610 nm
Test compound	*Benzaldehyde*	*Acetone*	*Chlorogenic acid*	*Brilliant blue*
Typical baseline noise (mAU)				
Proposed detector	3.1	1.0	2.6	1.6
Agilent DAD	0.31	0.15	0.76	0.38
Baseline drift (mAU/5 min)				
Proposed detector	3.9	2.1	0.8	0.5
Agilent DAD	1.7	1.1	1.6	1.1
Sensitivity [AU/(mol/L)] (R^2)				
Proposed detector	4.5×10^3 (0.9998)	7.7 (0.9996)	7.4×10^3 (0.9989)	2.0×10^4 (0.9995)
Agilent DAD	5.6×10^3(0.9995)	8.3 (0.9997)	11×10^3 (0.9996)	2.9×10^4 (0.9998)
Deviation from linearity [%]				
Proposed detector	31.5 @ 0.97 AU	8.0 @ 1.10 AU	15.6 @ 1.10 AU	28.1 @ 1.40 AU
Agilent DAD	2.2 @ 0.90 AU	3.2 @ 1.15 AU	2.3 @ 0.96 AU	5.4 @ 1.37 AU
Dynamic range upper limit [AU] (4σ of the absorbance signal)				
Proposed detector	1.99 (0.032)	1.99 (0.020)	2.05 (0.024)	1.95 (0.032)
Agilent DAD	1.97 (0.006)	2.13 (0.002)	2.36 (0.020)	2.61 (0.060)

Figure: Chromatography separation of the mixture of PAHs using proposed detector and Agilent DAD with 80 nL flow cell



Description: Absorption spectra recorded at maximum of selected peaks (insets). Column: Kinetex 2.6 µm XB-C18 0.3×100 mm; Sample: 1.96 µL, mixture of 16 PAHs, 2 µg mL^{-1} each in 20/80 (v/v) acetonitrile-water mixture. Linear gradient of acetonitrile-water composition: t_0 - 60/40 (v/v), $t_5$min – 90/10 (v/v); Flow: 10 µL/min; Temperature: ambient

Table: Chromatography Performance

Compound	Acenaphthylene	Anthracene	Pyrene	Dibenz(a,h) anthracene
Retention time [min]	2.14	3.07	3.66	5.65
Proposed detector				
Peak variance [µL²]	0.037	0.082	0.057	0.053
Peak asymmetry	1.09	1.16	1.12	1.12
Agilent DAD with 80-nL cell				
Peak variance [µL²]	0.042	0.069	0.064	0.054
Peak asymmetry	1.16	1.21	1.18	1.18

CONCLUSION

- The proposed setup offers **multichannel detection** and it is **ideal for portable microcolumn HPLC systems**;
- While sensitivity, linearity, and dynamic range are slightly lower compared to a benchtop DAD with an 80 nL flow cell, the chromatograms and UV-Vis spectra from a 0.3×100 mm column are similar;
- **The main limitation** is baseline noise, which is 4-10 times higher than noise of the benchtop DAD;
- Optimizing the proposed detector's design - by improving base signal strength, reducing CCD integration time, and applying spectral averaging - could significantly reduce noise;
- Enhancements such as optical fiber coupling or using a higher-performance CCD spectrometer would make the detector a more competitive option for portable microcolumn HPLC systems while maintaining its compact and versatile advantages.

ACKNOWLEDGEMENT

This research was funded by the Ministry of the Interior of the Czech Republic (*grant no. VB02000015*) and conducted at the Institute of Analytical Chemistry of the Czech Academy of Sciences (*Institutional research plan RVO:68081715*).