Orthogonal Pressurized Planar Electrochromatography (OPPEC)

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HPTLC 2014, Lyon

O U T L I N E

Introduction

Principle of action of OPPEC

Device for OPPEC

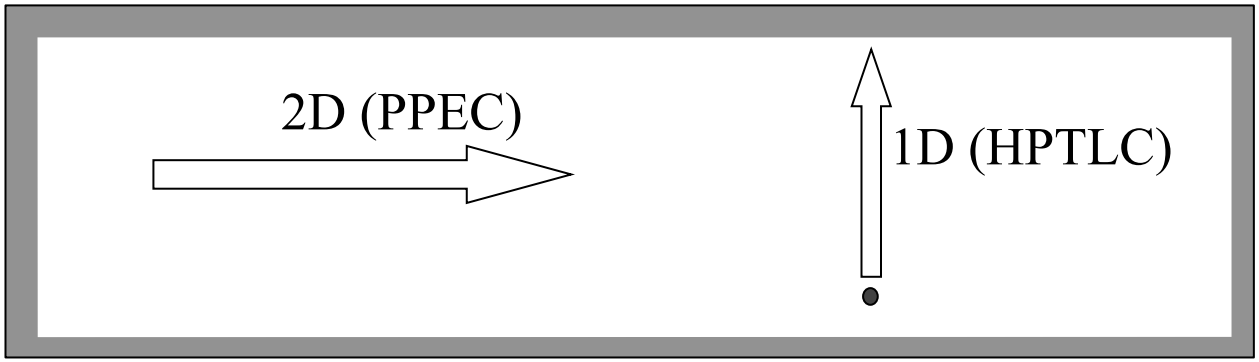
Exampes of separations with OPPEC

Challenges

Conclusions

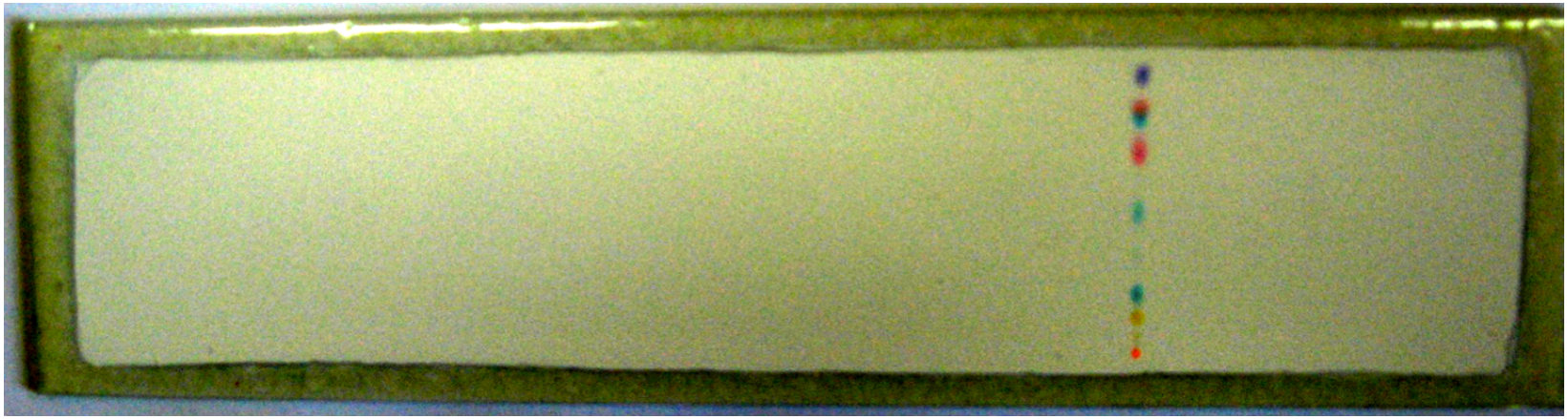
Introduction

Different selectivity is advantageous with respect to application of PPEC to two-dimensional (2D) separations.



Principle of two dimensional separation with HPTLC and PPEC (2D HPTLC/PPEC). Chromatographic plate with margins of silicone sealant on its whole periphery. Starting spot of the mixture to be separated is marked with a dot. Directions of the mobile phase migration in (1D) TLC and (2D) PPEC processes is marked with arrows.

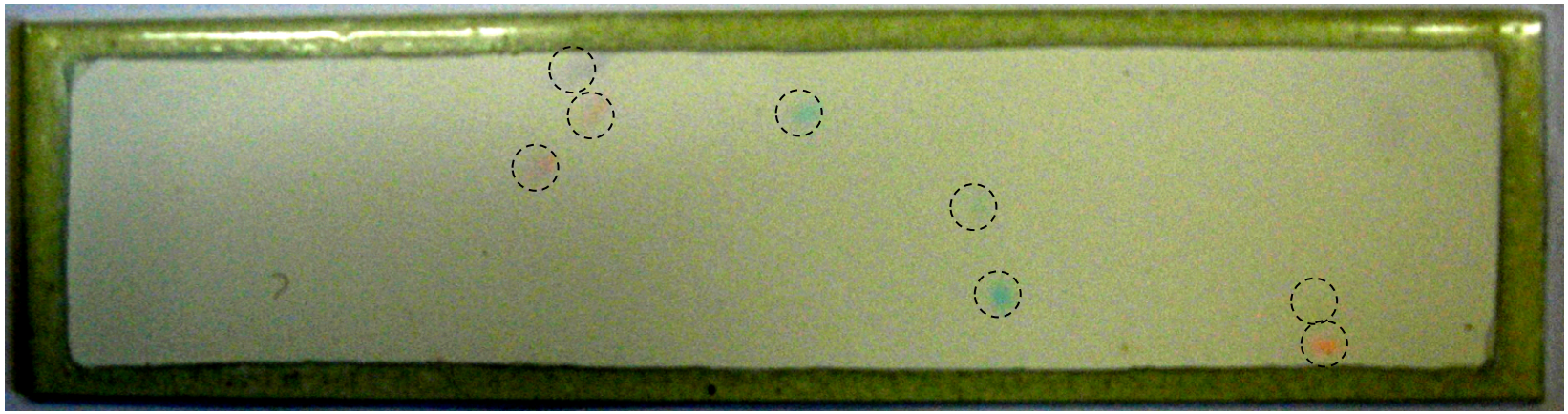
1D



Digital picture of TLC chromatogram, HPTLC RP18W plate (Merck), mobile phase: 45% methanol in buffer pH 3.0;
(1) rhodamine 6G, (2) PAR, (3) patent blue, (4) green S, (5) azorubine, (6) brilliant blue, (7) allura red, (8) brilliant black.

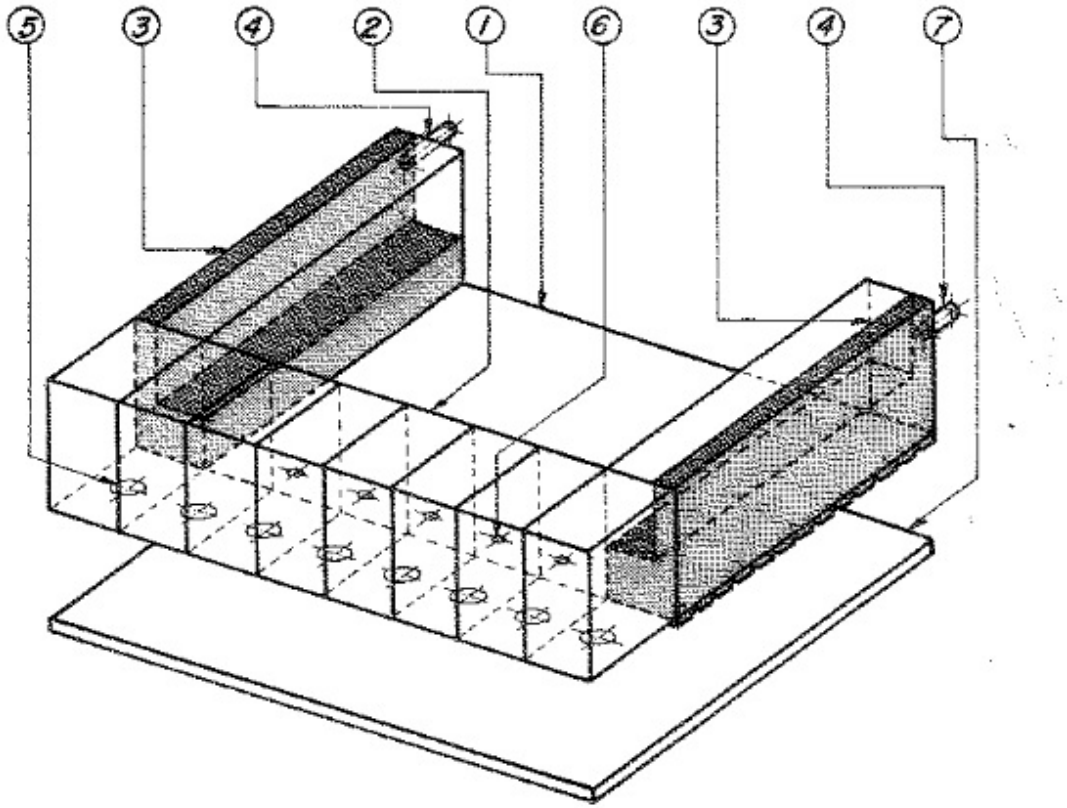
A. Chomicki, P. Ślązak, T.H. Dzido Electrophoresis 30 (2009) 3718 - 3725.

2D



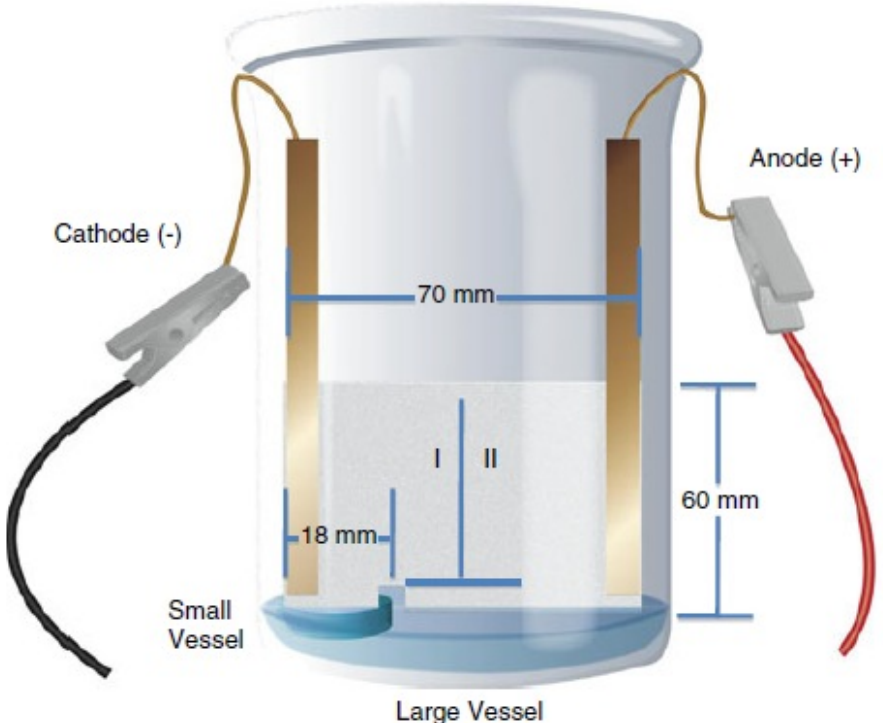
Digital picture of the chromatographic plate after 2-D HPTLC/PPEC separation, the mobile phase of the first dimension (HPTLC) as in previous slide, the mobile phase of the second dimension (PPEC): 75 % ACN in buffer pH 3.0, polarization voltage 2.5 kV.

A. Chomicki, P. Ślązak, T.H. Dzido Electrophoresis 30 (2009) 3718 - 3725.



Apparatus for simultaneous chromatogoaphy and electrophoresis; 1 - 20x20 cm plae of 2 mm thickness, 2 - electrolyte reservoirs, 3 – graphite electrodes, 4 - electrical connectors, 5 - sintered glass disc OD 11 mm and thickness 3 mm, 6 – holes for sample applications, 7 - TLC plate

W.J. Van Ooij, J. Chromatogr. 1973, **81,** 190.



Simultaneous chromatography and electrophoresis (SCE) apparatus with dual solvent reservoir. TLC plate depicts sections I and II for characterization of horizontal migration

Peter R. Stevenson et al. Anal Bioanal Chem (2013) 405:3085–3089

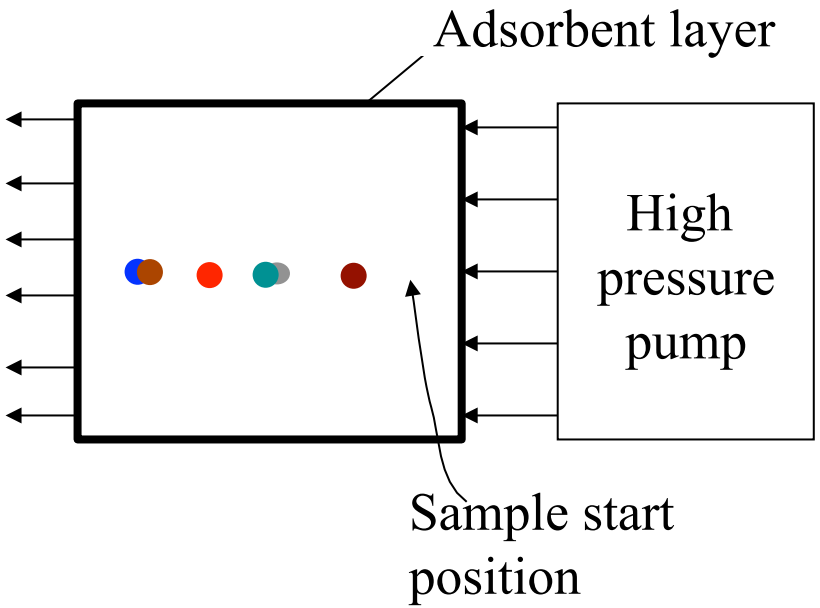
Principle of action of OPPEC

OPPEC = OPLC + PPEC

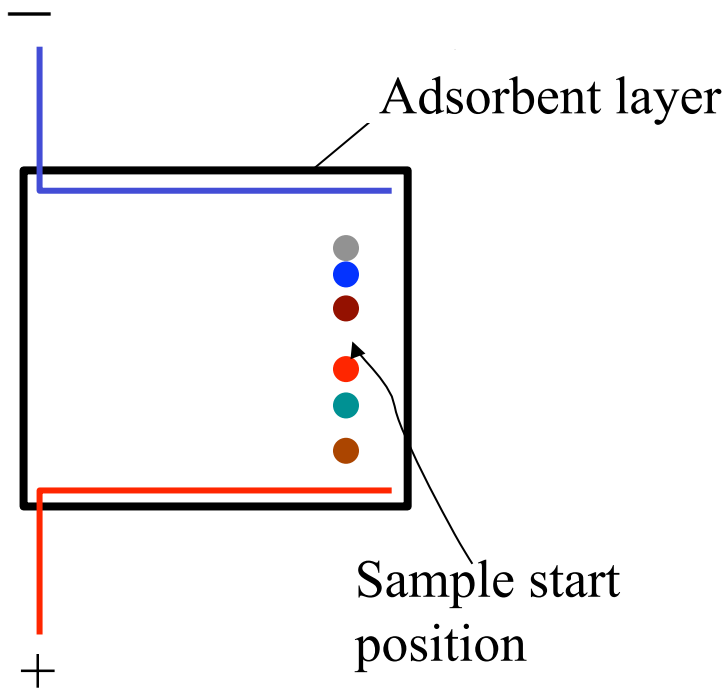
OPPEC = Orthogonal Pressurized Planar Electrochromatography

OPLC = Overpressure Layer Chromatography

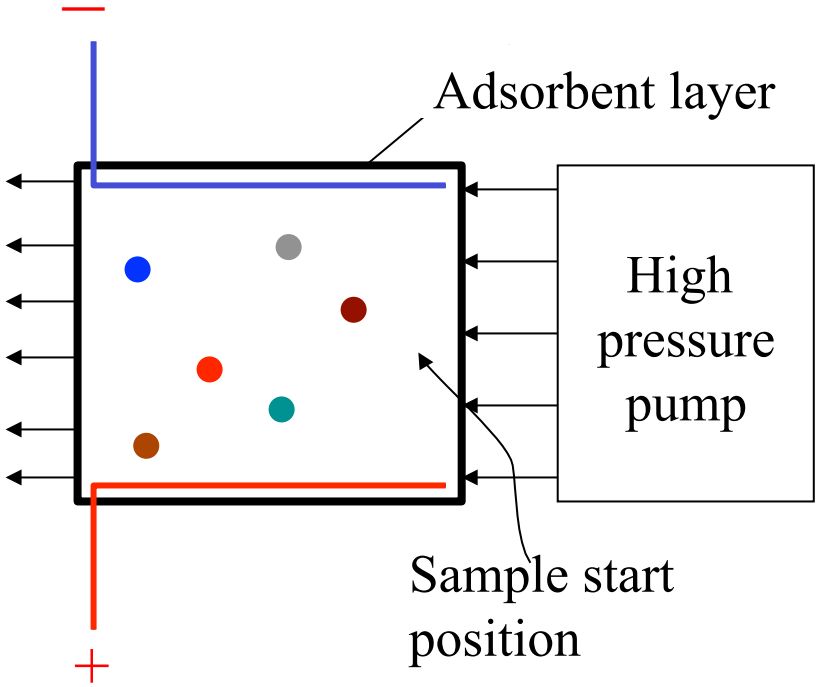
PPEC = Pressurized Planar Electrochromatography



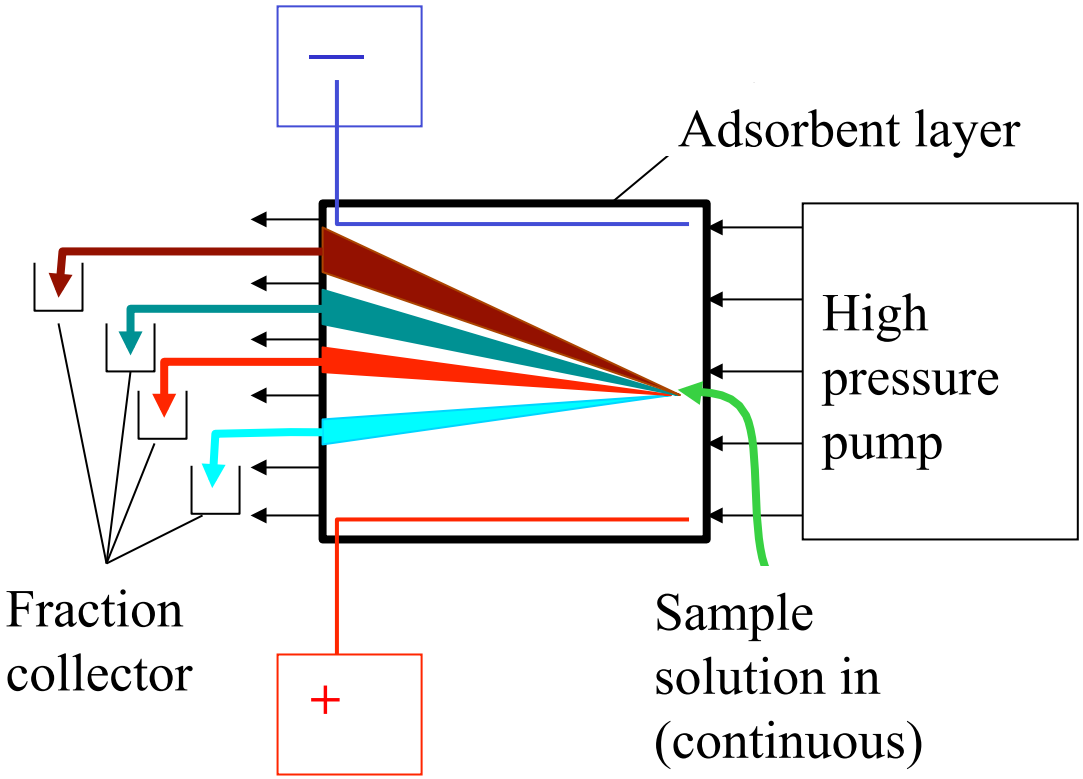
Principle of action of the device for Overpressure Layer Chromatography (OPLC)



Principle of action of the device for
Pressurized Planar Electrochromatography (PPEC)

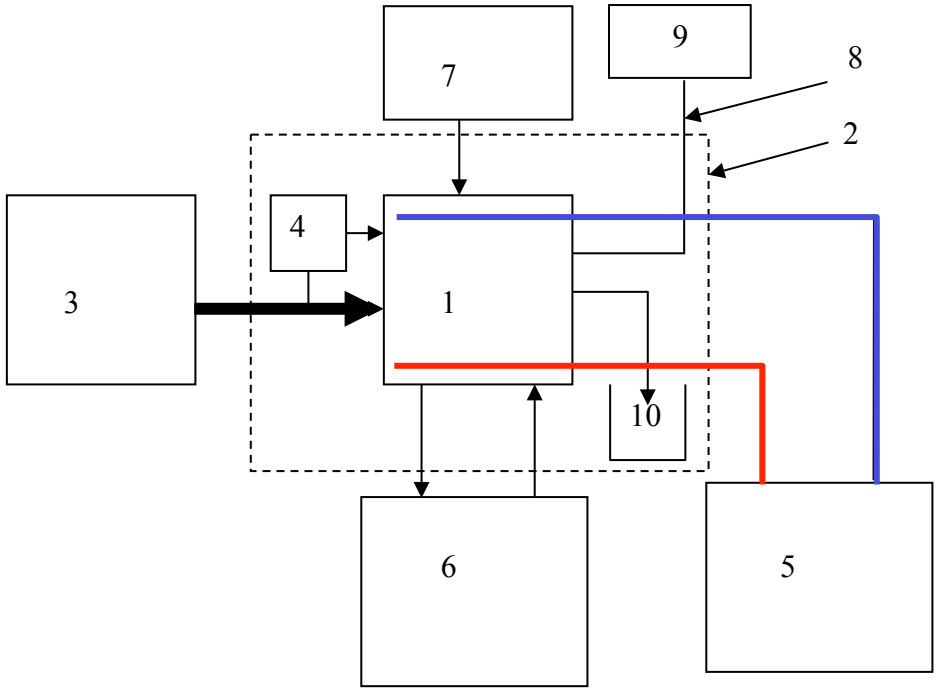


Principle of action of the device for Orthogonal Pressurized Planar Electrochromatography (OPPEC)
- analytical mode



Principle of action of the device for
Orthogonal Pressurized Planar Electrochromatography
- preparative mode

Device for OPPEC

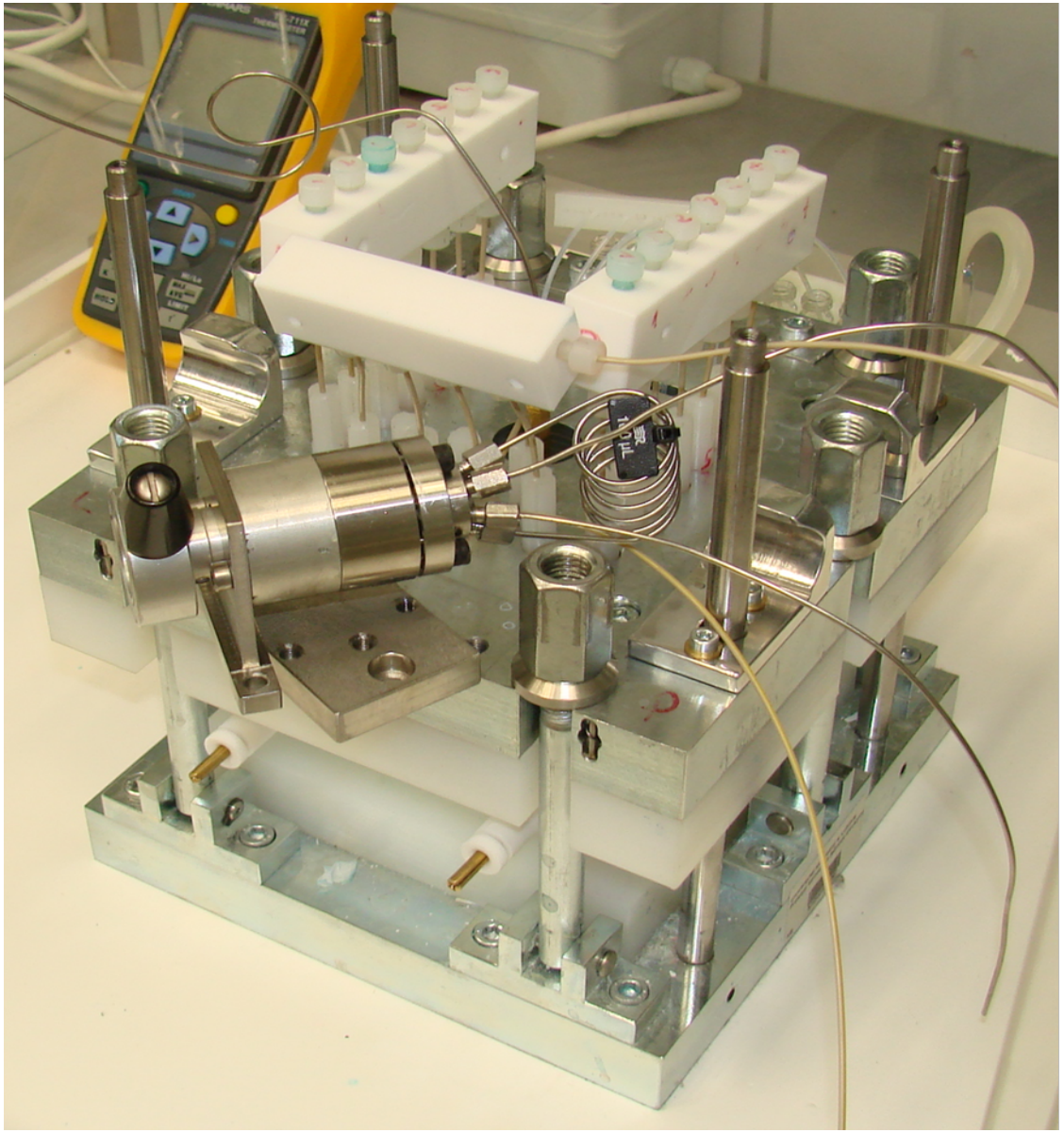


Conceptual view of the device for orthogonal pressurized planar electrochromatography (OPPEC):

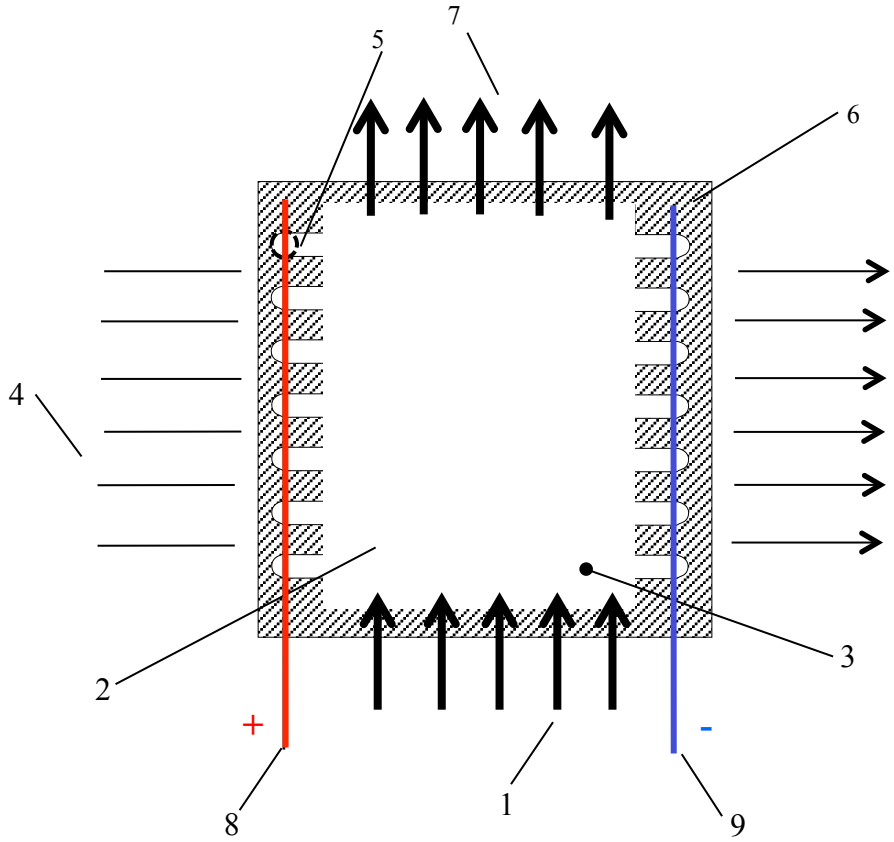
1 – OPPEC chamber, 2 – security cabinet, 3 – syringe pump, 4 – microinjection valve, 5 – DC high voltage power supply, 6 - thermostat , 7 - hydraulic pump, 8 – thermocouple, 9 – temperature digital display, 10 – waste reservoir

T. Dzido, E. Łopaciuk, P. Płocharz, A. Chomicki, M. Zembrzycka, H. Frank. Equipment and preliminary results for orthogonal pressurized planar electrochromatography, J. Chromatogr. A 1334 (2014) 149 - 155.

The picture of the complete OPPEC device for continuous separation

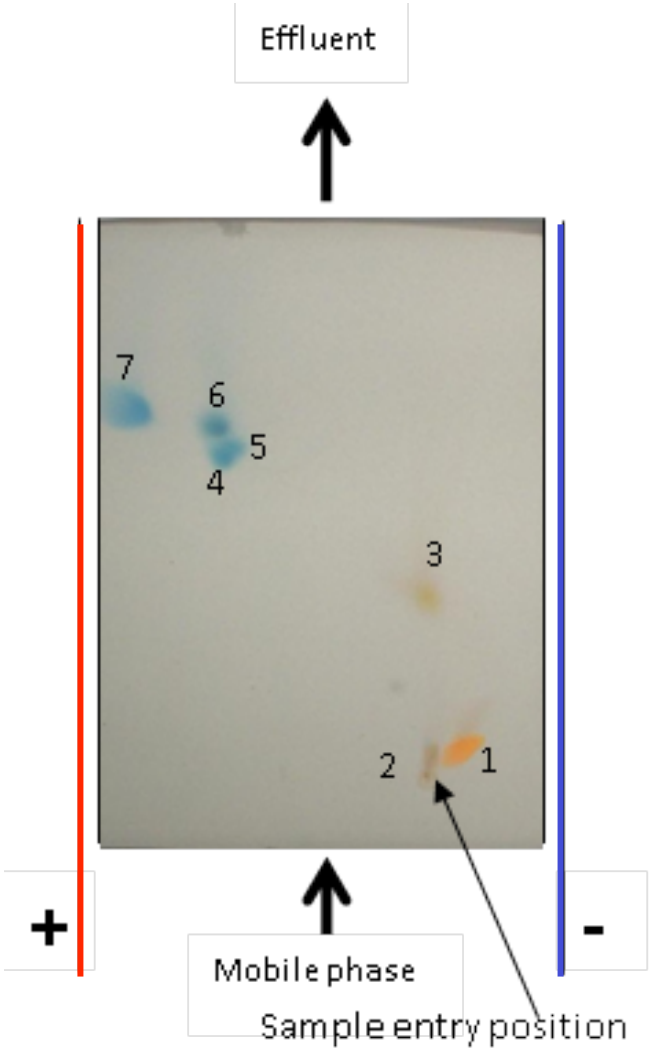


Photography of the OPPEC chamber (patent pending)



Conceptual view of principle of action of the OPPEC chamber, 1 – mobile phase in, 2 – chromatographic plate, 3 – sample entry position, 4 - direction of electric field, 5 – electrode compartment (it is above the chromatographic plate), 6 – sealing margin, 7 – mobile phase out, 8 –anode, 9 – cathode; patent pending

Examples of separations with OPPEC



The picture of the chromatographic plate after OPPEC separation of a six food dye mixture (the plate is cut, with no sealing margin). Sample volume (1 μL) introduced with microsyringe, polarization voltage 1.0 kV, the mobile phase (70% ACN) flow velocity 75 L/min; (1) not identified dye, (2) rhodamine G, (3) PAR, (4) green S, (5) patent blue, (6) brilliant blue, (7) brilliant black.

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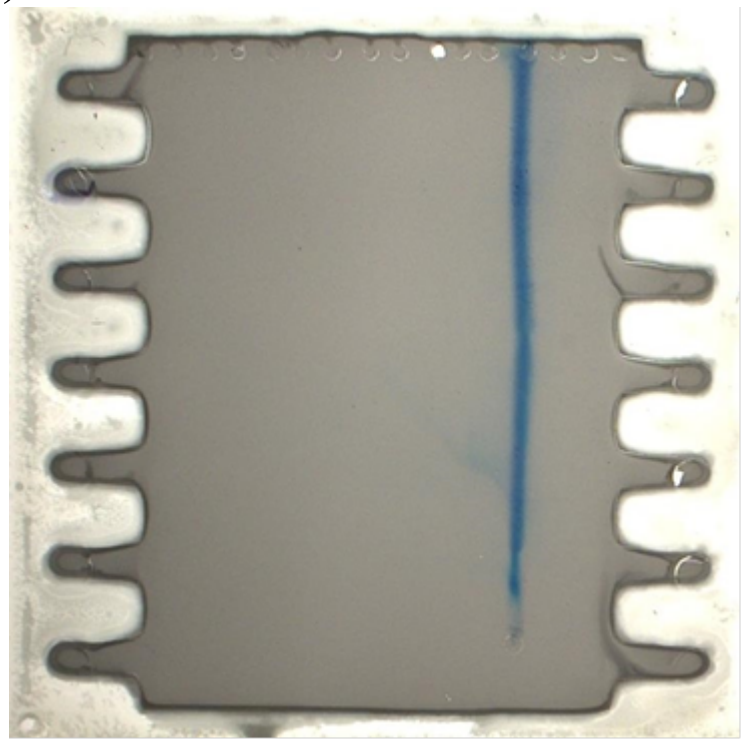
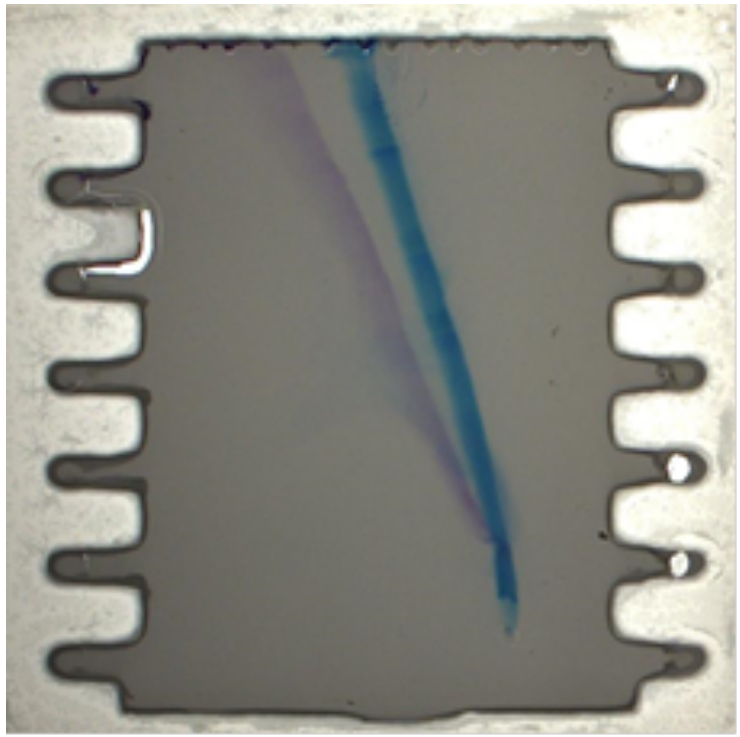
(a)



(b)



(a) The picture of the chromatographic plate after OPLC separation of two dye mixture: (1) patent blue and (2) brilliant black (no electric field was applied, and (b) after OPPEC separation, polarization voltage 1.0 kV, the mobile phase 30% ACN, mobile phase flow velocity 100 µL/min, sample solution flow velocity 1.0 µL/min;

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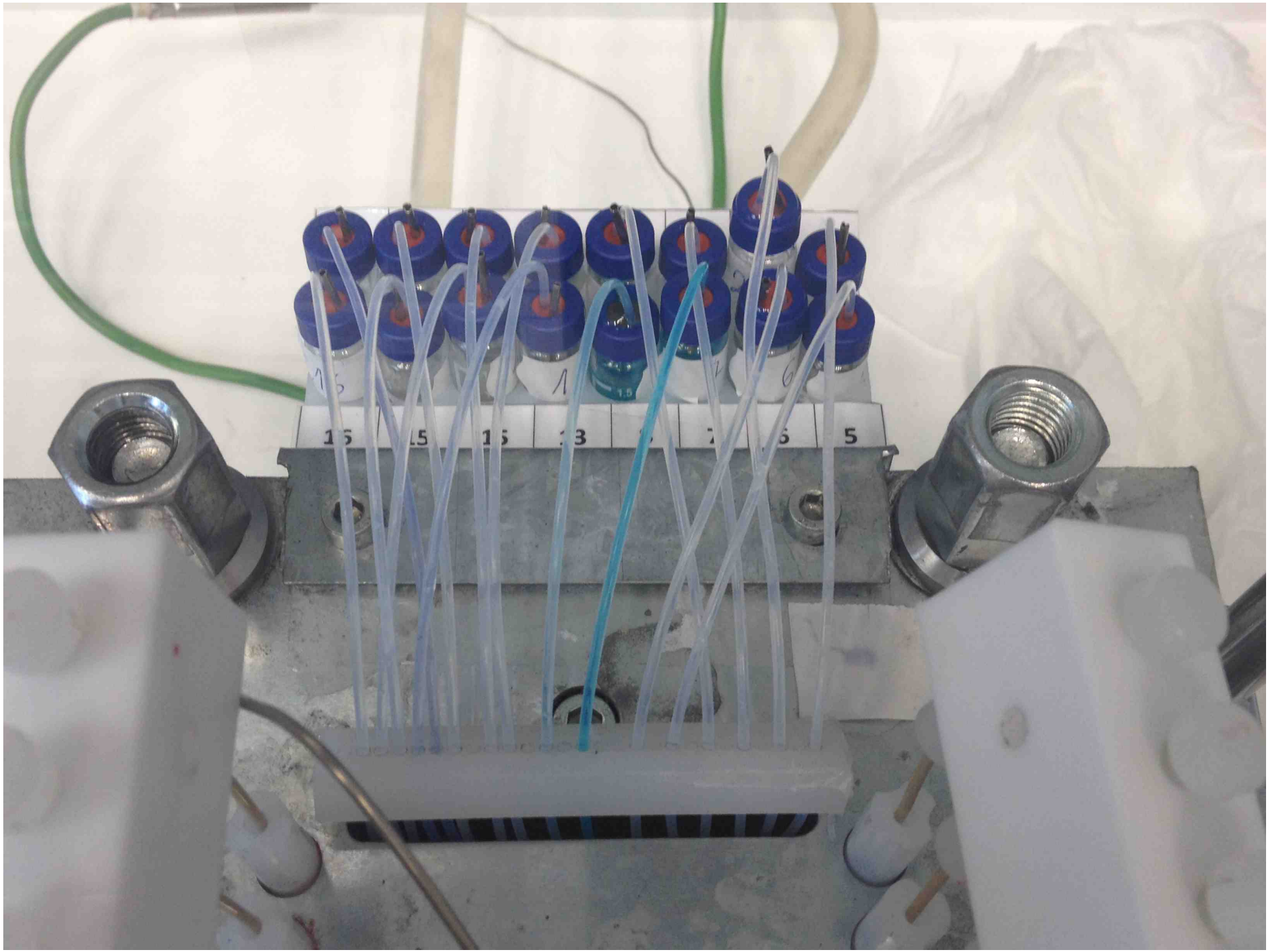
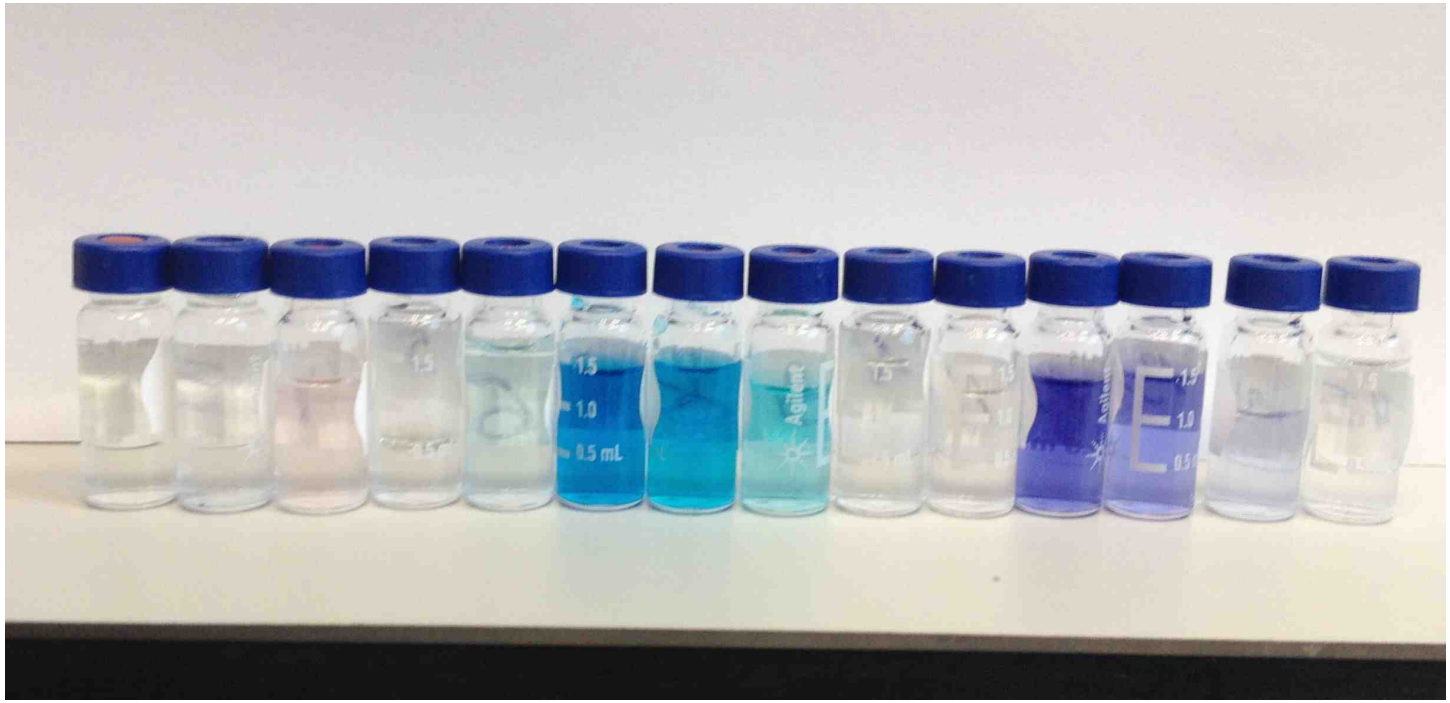
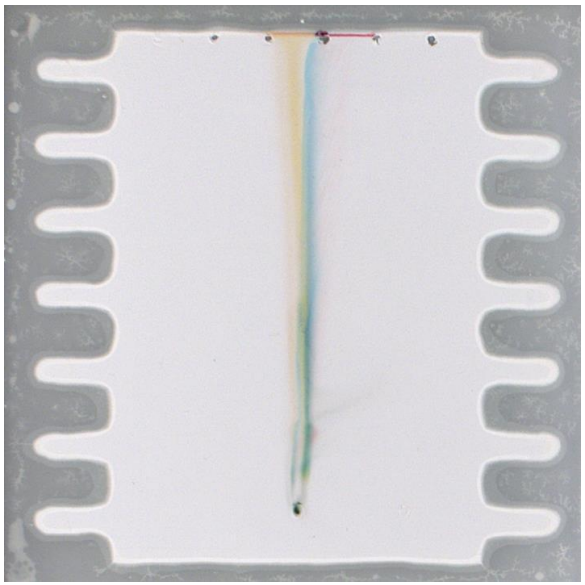
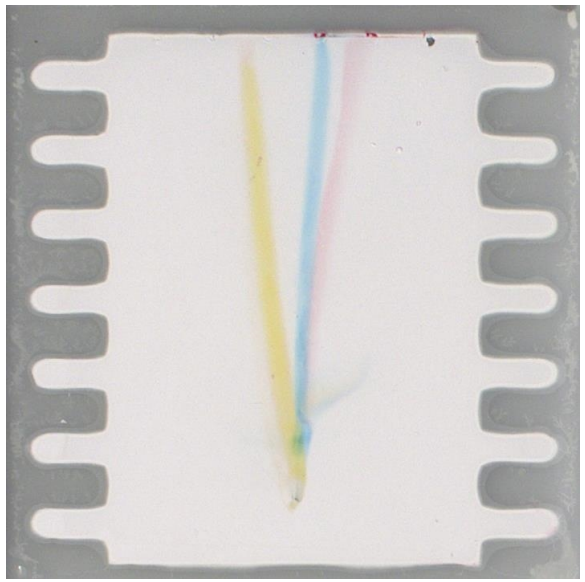


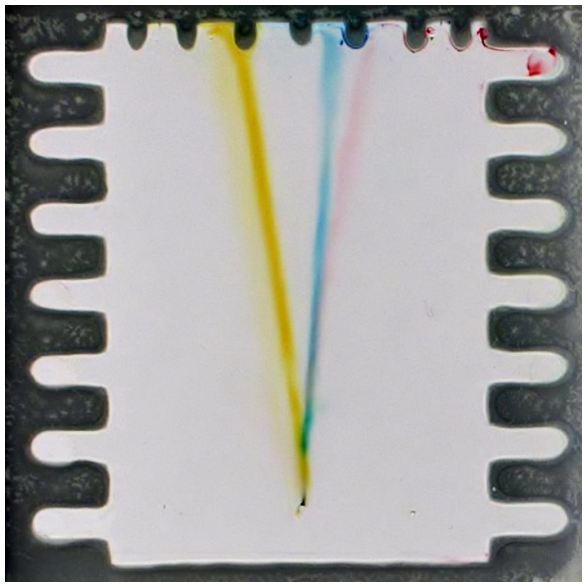

1.5
1.0
0.5 mL



Buffer pH = 2.0



pH = 3.2



pH = 7.4

Stationary phase: HPTLC RP18W (Merck); mobile phase: 45% methanol i buffer, potential 1.0 kV; flow velocity of the mobile phase: 0.1 mL/min; flow velocity of sample (patent blue, PAR, azorubine) solution 0.0004mL/min; time of experiment 120 min

The challenges:

- development of equipment
- repeatability
- Joule heat generation
- sample application/injection
- stationary phases (chromatographic plates or ...?)

Conclusions

Orthogonal pressurized planar electrochromatography is especially attractive for preparative separations, however, its application to analytical mode requires further investigations.