

**Selective electrochemical detection of dopamine in microfluidic channel on
carbon nanoparticulate electrodes**

Ewa Rozniecka, Martin Jonsson-Niedziolka*, Anna Celebanska, Joanna Niedziolka-Jonsson
and Marcin Opallo*

*Institute of Physical Chemistry, Polish Academy of Sciences, ul. Kasprzaka 44/52, 01-224
Warszawa, Poland*

Supplementary Material

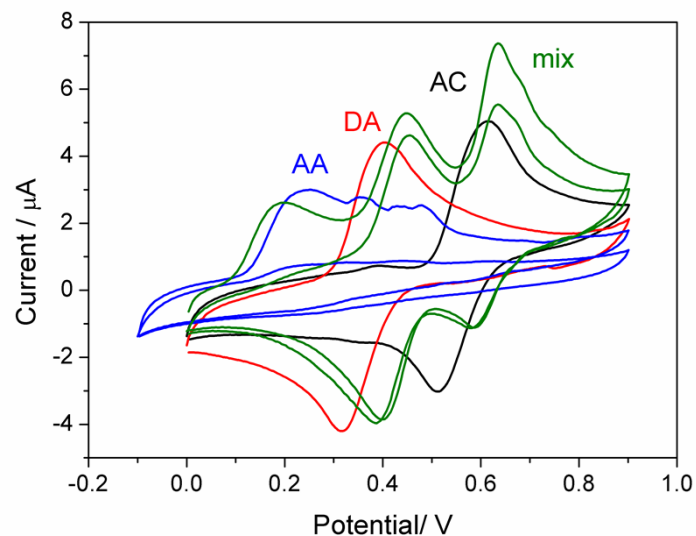


Fig S1. Voltammetry of 1 mM AA, 1 mM DA and 1 mM acetaminophen AC in phosphate buffer (pH 5) and mixture of these analytes (1 mM each) in the cell presented in Fig. 1 under quiescent conditions. Scan rate 20 mV s^{-1} .

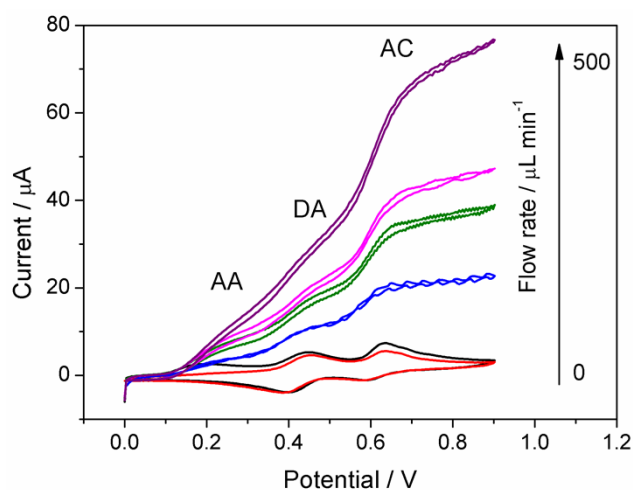


Fig S2. Hydrodynamic voltammograms obtained in a mixture of 1 mM AA, 1 mM DA and 1 mM AC solution in phosphate buffer (pH 5) recorded at different flow rates (10 – 500 $\mu\text{l min}^{-1}$, marked on the plot). Scan rate 20 mV s^{-1} .

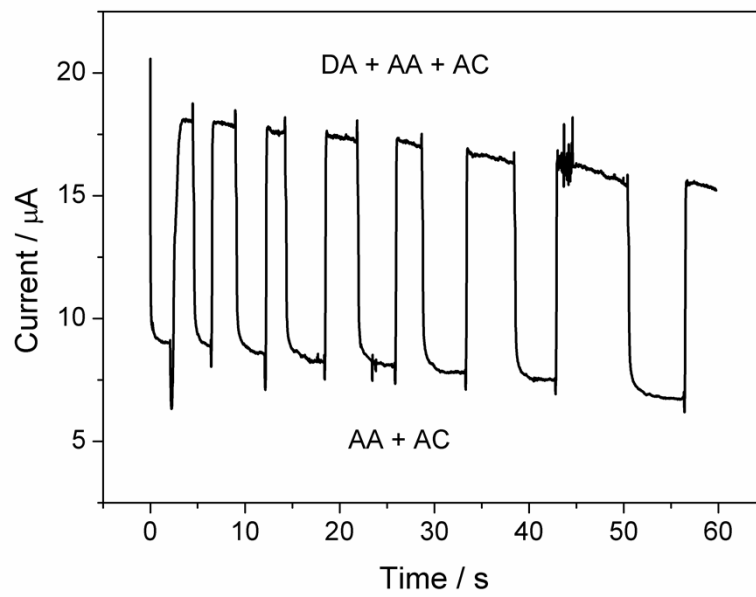


Fig. S3. Current-time response obtained in 1 mM AA,AC,DA solution (upper part) and in 1 mM AA,AC solution (lower part) in phosphate buffer (pH 5) in potentiostatic conditions at $E = 450$ mV.

Table S1. Parameters used for the simulations of voltammograms presented on Fig. 2.

| Variable | Value |
|---------------|--|
| $E_{0,AA}$ | 1.11 V |
| $k_{0,AA}$ | 1.33×10^{-7} m/s |
| α_{AA} | 0.6 |
| D_{AA} | 4.4×10^{-10} m ² /s |
| $E_{0,DA}$ | 0.354 V |
| $k_{0,DA}$ | 1.03×10^{-5} m/s |
| α_{DA} | 0.5 |
| D_{DA} | 6.75×10^{-10} m ² /s |
| $E_{0,AC}$ | 5.56 V |
| $k_{0,AC}$ | 3.01×10^{-5} m/s |
| α_{AC} | 0.6 |
| D_{AC} | 7.54×10^{-10} m ² /s |

Table S2. The selected data as limit of detection of dopamine and linear range obtained in forced convection with electrochemical detection

| Electrode | LOD of DA | Linear range | Method | Reference |
|---|---|--|--|--|
| Highly dispersed hollow gold-graphene (HAu-G) nanocomposites on GCE | 0.05 μ M | 0.08 and 600 μ M | CV, DPV current-time response (stirring) | Colloids and Surfaces B: Biointerfaces, 111 (2013) 321 |
| SWNT | ~5 pM in PBS pH7.4 ~50 pM in artificial cerebral fluid | 5–1000 nM | FIA | Analytical Chemistry 85 (2013) 163 |
| A composite of SiO ₂ -coated GO and molecularly imprinted polymers(GO/SiO ₂ -MIPs) on GCE | 3.0x10 ⁻⁸ M | 5.0x10 ⁻⁸ to 1.6x10 ⁻⁴ M | CV, DPV, current-time response (stirring?) | Biosensors and Bioelectronics 45 (2013) 25 |
| Polyvinylpyrrolidone (PVP)/graphene modified glassy carbon electrode (PVP/GR/GCE) | 0.2 nM | 5x10 ⁻¹⁰ to 1.13x10 ⁻³ mol/L | CV, current-time response (stirring?) | Talanta 97 (2012) 557 |
| flow cell based on a rotating disk electrode (RDE-carbon paste) | few tenths of a nanogram | 1-10 ng mL ⁻¹ dopamine | amperometric detection | Analytical Chemistry 52 (1980) 203 |
| glassy carbon electrodes with tetraruthenated cobalt-porphyrin | “The very good signal to noise ratios obtained, ensure a detection limit at least 10 times smaller, i.e., in the ppb range” | 2x10 ⁻⁷ - 8x 10 ⁻⁷ M | FIA | Analytica Chimica Acta 329 (1996) 91 |
| Platinum disks coated with the poly(1,2-diaminobenzene) film and with a Nafion film, | 1.5 μ M | 0.002 – 20 mM | FIA with an on-line microdialysis sampling system | Analytical Sciences 24 (2008) 1469 |
| electrochemical measurements using magnetically-controlled droplet movement- Pt (WE) | | 26.4–132 mM | SWV, | Analyst 132 (2007) 412 |
| MWCNT modified CPEs unmodified CPE | 50 nM 500 nM | | FIA | Analyst 136 (2011) 3177 |
| Glassy carbon electrode | 42 pmol/l | | microbore ultrahigh performance liquid chromatography (UHPLC) with electrochemical | ACS Chemical Neuroscience 4 (2013) 888 |

| | | | detection | |
|--|---|---|--|--|
| graphene foam (GF)/ITO | 2 nM 20 nM (DPV) | Up to 10 μ M 0.5–100 mM in the presence of 0.1 mM AA (DPV) | CV, DPV, current-time response (stirring?) | Electroanalysis (2013) DOI: 10.1002/elan.201300297 |
| on-line microfluidic sensing device with an interdigitated array (IDA) carbon based electrode and a micro pre-reactor with Ascorbate oxidase | 108 pM and 1 nM of DA in the presence of 10 μ M of AA | 200 pM - 100 nM. | flow | Electrochemistry Communications 5 (2003) 1037 |
| Nafion-coated 10 μ m SECM Pt working electrode | | 1 to 25 mM | flow | Journal of Neuroscience Methods 124 (2003) 129 |
| Integrated CPEs into multilayer microfluidic device | 250 nM | | flow | Lab on a Chip 13 (2013) 208 |
| AuNPs-rGOS (reduced Graphene oxide sheets)-ITO | 6.0 - 10 ⁻⁸ M | 10 - 1000 μ M | CV, DPV, current-time response (stirring?) | Nanoscale 4 (2012) 4594 |
| Glass/Ti/Pt/Pd | 20 to 100 μ M, | 2 μ M | flow | Sensors and Actuators B 108 (2005) 688 |
| Au | 5- 250 μ M (for DA-derived DNA adduct), 2-350 μ M (for DA) | 5 μ M (for DA-derived DNA adduct), 2 μ M (for DA) | flow | Sensors and Actuators B 120 (2006) 42 |