ItalSens Carbon Screen Printed electrodes IS-C

1 Description

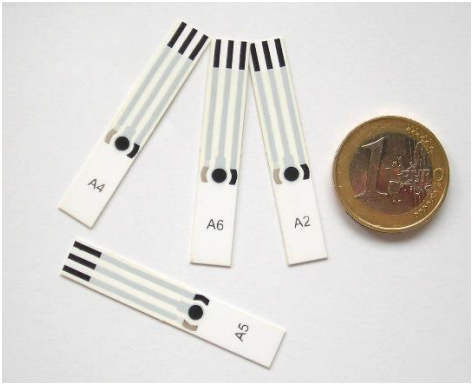

Figure 1 ItalSens IS-C cut into single units

The three electrode electrochemical cell has a graphite working electrode, suitable for a wide range of analytical applications. Each electrode is produced by screen-printing technology and constitutes of a circular graphite working electrode (3 mm diameter), a silver pseudoreference electrode and a graphite counter electrode. The small electrode dimensions reduce the required sample volumes and the low costs permit disposable use.

The electrodes are delivered as strips of 20 pieces, which need to be manually cut.

Samples can be applied as a droplet due to the electrodes design. This avoids the waste of reagents and samples. The graphite can be modified through direct adsorption, chemical binding, etc., and a wide range of biomolecules can be linked to the electrode surface. These customizations make the graphite electrodes suitable for a broad spectrum of applications.

1.1 Application Advice

The silver pseudo-reference electrode shows higher stability in the presence of chloride ions. Hence, it is recommended that measurements are carried out in solutions with a chloride ion concentration of at least 10 mM.
We also recommend the following literature regarding the use of preliminary electrochemical treatment of SPE to increase the useful potential range:

- Wang J. et al., Electrochimica Acta, 43, 23, 3459-3465, 1998, https://doi.org/10.1016/S0013-4686(98)00092-9
- Kroger S. et al., Analytica Chimica Acta, 347, 9-18, 1997, https://doi.org/10.1016/S0003-2670(96)00634-4

2 Technical Specifications

Dimensions: 0.8 x 4.5 cm
Working electrode dimensions: 7.06 mm²
Thickness: 450 µm
Contact pad pitch: 2.54 mm
Coefficient of Variation (CV) (n = 10): 5 %

3 Measurements

All measurements were performed with a droplet of solution covering all three electrodes of the cell. The solution contained 2.5 mM $K_3[Fe(CN)_6]$, 2.5 mM $K_4[Fe(CN)_6]$ and 0.1 M KCl.

3.1 Cyclic Voltammogram

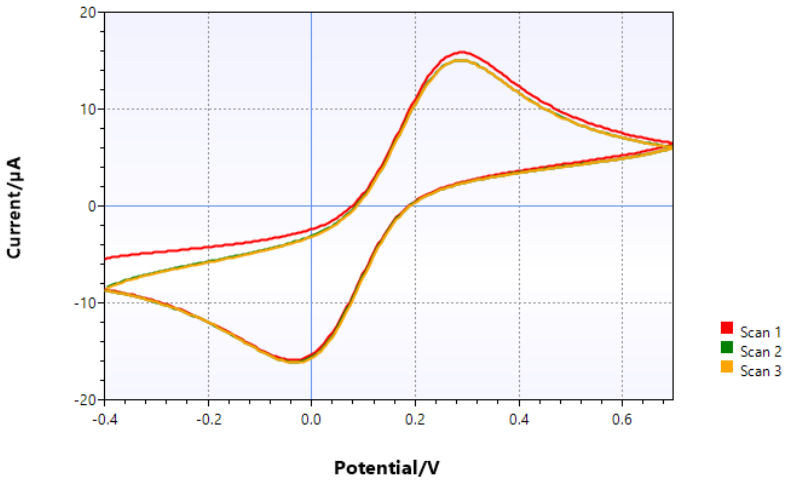

Figure 2 CV, IS-C, scan rate 0.1 V/s, E step 5 mV

3.2 Differential Pulse Voltammogram

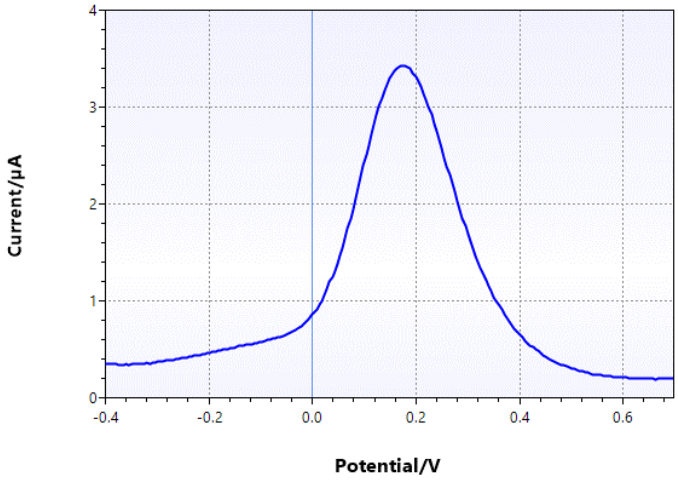

Figure 3 DPV, IS-C, scan rate 25 mV/s, E step 5 mV, E pulse 25 mV, t pulse 20 ms

3.3 Electrochemical Impedance Spectroscopy

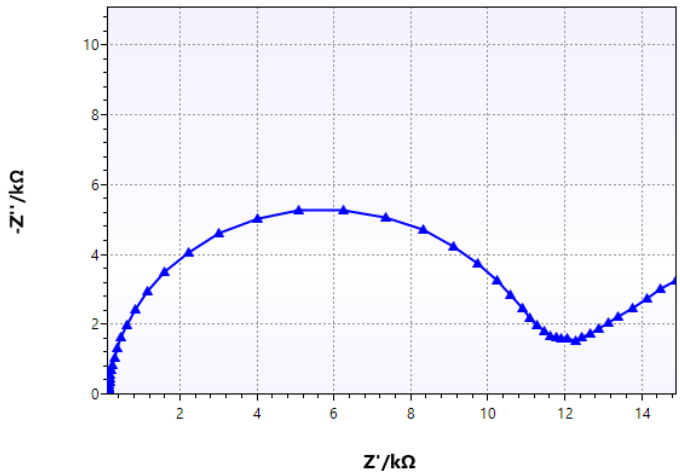

Figure 4 EIS, IS-C, E dc OCP, E ac 10 mV, frequency range 0.1 Hz to 1 MHz

4 Application Examples from Peer-Reviewed Publications

4.1 Sensor for Heavy metal detection

- I. Palchetti, A. Cagnini, M. Mascini, A.P.F. Turner, "Characterisation of screen-printed electrodes for detection of heavy metals ", Mikrochimica Acta, 131, n. 1-2, 1999, 65-73. https://doi.org/10.1007/s006040050010
- I. Palchetti, C. Upjohn, A.P.F. Turner, M. Mascini, "Disposable screen-printed electrodes (SPE) mercury-free for the lead detection", Analytical Letters, 33, 7, 1231-1246, 2000 https://doi.org/10.1080/00032710008543119
- I. Palchetti, G. Marrazza, M. Mascini, "New procedures to obtain electrochemical sensors for heavy metal detection", Analytical Letters, 34 (6) 2001. https://doi.org/10.1081/AL-100103594
- I. Palchetti, A. Kicela, S. Majid, G. Marrazza, M. Mascini, "Polymer-mercury coated screen-printed sensors for electrochemical stripping analysis of heavy metals", Int. Journal of Environmental Analytical Chemistry, accepted 2002. https://doi.org/10.1080/0306731021000049617

4.2 Potentiometric screen-printed cell

- R. Konchi, S. Glab, J. Dziwulska, I. Palchetti, M. Mascini, "Disposable strip potentiometric electrodes with solvent-polymeric ion-selective membranes fabricated using screen-printing technology", Analytica Chimica Acta, 385, 1-3, 1999, 451-459. https://doi.org/10.1016/S0003-2670(98)00726-0

4.3 Sensor and Biosensor for phenol and polyphenol detection

- C. Capannesi, I. Palchetti, M. Mascini, A. Parenti, “Electrochemical sensor and biosensor for polyphenol detection in olive oils”, Food Chemistry,71,4,553-562, 2000. https://doi.org/10.1016/S0308-8146(00)00211-9

4.4 DNA biosensor

- M. Mascini, I. Palchetti, G. Marrazza, “DNA electrochemical biosensor”, Fresenius’ Journal of Analytical Chemistry, (2001) 369, 15-22. https://doi.org/10.1007/s002160000629
- F. Lucarelli, I. Palchetti, G. Marrazza and M. Mascini, “Electrochemical DNA Biosensor as a Screening Tool for the Detection of Toxicants in Water and Wastewater Samples”, Talanta, 56, 5, 949-957, 2002. https://doi.org/10.1016/S0039-9140(01)00655-5
- F. Lucarelli, A. Kicela, I. Palchetti, G. Marrazza and M. Mascini, “Electrochemical DNA Biosensor for Analysis of Wastewater Samples”, Bioelectrochemistry, 58, 1, 113-118 2002 https://doi.org/10.1016/S1567-5394(02)00133-0
- F. Lucarelli, G. Marrazza, I. Palchetti, S. Cesaretti and Marco Mascini, “Coupling of an indicator-free electrochemical DNA biosensor with polymerase chain reaction for the detection of DNA sequences related to the apolipoprotein E”, Analytica Chimica Acta, 469, 93-99, 2002 https://doi.org/10.1016/S0003-2670(02)00605-0

4.5 Immunosensor

- J. Killard, L. Micheli, K. Grennan, M. Franek, V. Kolar, D. Moscone, I. Palchetti, M. R. Smyth, “Amperometric separation-free immunosensor for real-time environmental monitoring”, Analytica Chimica Acta, 427, 2, 173- 180, 2001. https://doi.org/10.1016/S0003-2670(00)01015-1
- Serena Laschi, Milan Fránek, Marco Mascini, “Screen- Printed Electrochemical Immunosensors for PCB Detection”, Electroanalysis, 2000, 12, No. 16, 1293-1298. https://doi.org/10.1002/1521-4109(200011)12:16%3C1293::AID-ELAN1293%3E3.0.CO;2-5
- S. O'Neill, S. Laschi, I. M. Davies, L. Webster, L. A. Campbell, C. F. Moffat, “Immunological detection of PCBs in environmental samples using a screen printed electrode biosensor and differential pulse voltammetry”, Fisheries Research Service Report No 05/00. https://bit.ly/2PuRM6H
- Serena Laschi, Marco Mascini, “Disposable electrochemical immunosensor for PCB detection”, Annali di Chimica, 2002, 92, pag. 425-433. https://doi.org/10.1142/9789812792013_0004

4.6 Biosensor for Pesticide Analysis

- Cagnini, I. Palchetti, I. Lionti, M. Mascini, A.P.F. Turner, “Disposable ruthenized screen-printed biosensors for pesticides monitoring”, Sensors and actuators B 24-25, (1995), 85-89. https://doi.org/10.1016/0925-4005(95)85018-X
- Cagnini, I. Palchetti, M. Mascini, A.P.F. Turner, “Ruthenized Screen-printed Choline Oxidase-Based Biosensors for measurement of anticholinesterase Activity”, Mikrochim. Acta 121, 155-166 (1995). https://doi.org/10.1007/BF01248248
- Palchetti, A. Cagnini, M. Del Carlo, C. Coppi, M. Mascini, A.P.F. Turner, “Determination of anticholinesterase pesticides in real samples using a disposable biosensor”, Analytica Chimica Acta, 337 (1997) 315-321. https://doi.org/10.1016/S0003-2670(96)00418-7
- S. Hernandez, I. Palchetti, M. Mascini, “Determination on Anticholinesterase activity for pesticides monitoring using Acetylthiocholine Sensor”, Int. Journal of Environmental Analytical Chemistry, 78, 3-4, (2000), 263-278 https://doi.org/10.1080/03067310008041346