

## A Universal Voltammetric Cell

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In electroanalytical research it is desirable to work with a cell which is easily used for various electrochemical measurements. The requirements for such a cell are: 1) ability to function with different types of electrodes, 2) perfectly reproducible hydrodynamic conditions, 3) simple replacement of the sample and electrodes, and 4) construction material which is inert in respect to the sample.

Adsorption/desorption processes on cell walls play an important role in the determination of very low concentrations of heavy metals. It has been found that adsorption on the walls of a pyrex-glass cell (also if siliconized), causes serious errors when heavy metal concentrations are below  $10^{-7}$  M. However, adsorption of Zn, Cd, Pb and Cu has been found to be negligible during analysis in a polyethylene cell<sup>1</sup>.

A universal cell (Fig. 1) suitable for anodic stripping voltammetry and other electrochemical studies, which employs different types of rotating electrodes as well as dropping mercury or stationary electrodes, is described.

A polyethylene bottle of 125 ml (Kartell-Milano) with the top part removed was used as a vessel (Fig. 1, No 1), but a vessel of any other convenient material (teflon, quartz, glass, etc.) can also be used. The top of the cell is a teflon cap (2), fixed to a perspex stand-plate (3) by four screws, drilled to accept the threaded rotating electrode holder (4), reference electrode compartment (5), platinum counter-electrode compartment (6), dropping or hanging mercury drop electrode (7), and the teflon inlet-outlet tubings for inert gas (8).

The reference and counter electrode compartments, if made from glass, should be siliconized in order to minimize adsorption.

Using the teflon stoppers (9), electrodes, compartments, and tubings can be easily replaced.

The rotating electrode holder consists of a perspex tubing (4) with a stainless steel shaft (10) on a teflon- (11) and ball- bearing (12), as well as a perspex mercury pool container (13). A stainless steel bell (14) is used to obtain a noise-free contact between the shaft and the mercury pool (15). This type of electrical contact eliminates the possibility of sample contamination due to the »dust« at metal-slide contacts.

The rotating electrode consists of a glass or quartz tube (16) with a disk electrode (17), heat sealed (platinum) or glued (glassy carbon, silver) in one

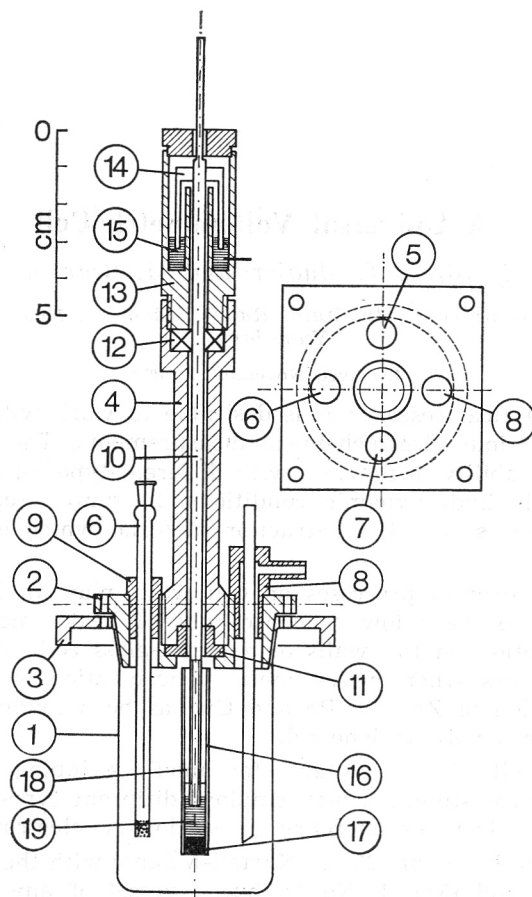


Fig. 1. The universal cell for electrochemical studies: 1) polyethylene vessel; 2) teflon cap; 3) stand-plate; 4) rotating electrode holder; 5) hole for reference electrode compartment; 6) counter electrode compartment; 7) hole for dropping or hanging mercury drop electrode; 8) inlet-outlet tubings for inert gas; 9) teflon stopper; 10) stainless steel shaft; 11) teflon-bearing; 12) ball-bearing; 13) mercury pool container; 14) stainless steel bell; 15) mercury pool; 16) glass or quartz tube; 17) disk electrode; 18) screw-nut; 19) mercury.

side, and a perspex, rod-like screw-nut (18) glued into other side. Their diameters are matched to the internal diameter of the tube. The stainless steel shaft is threaded and enables the simple fixing of the electrode on the shaft by means of the perspex nut (18). Mercury (19) insures the electrical contact between the shaft and the rotating disk electrode. This rotating electrode can also be used as a stirrer, when anodic stripping is applied to other types of electrodes. By means of a synchronous electromotor a constant rotation speed can be maintained.

The cell described above was successfully employed in the determination of traces of heavy metals in sea water<sup>1</sup>. The anodic stripping voltammetric technique was used in the determination of traces of cadmium, lead and copper at a mercury coated glassy carbon rotating electrode<sup>2</sup> as well as zinc at a slow dropping mercury electrode<sup>3</sup>. Reproducibility of the anodic

peak currents was good and the described cell can be applied in the determination of metals in concentrations as low as  $10^{-9}$  M. This concentration range corresponds to the heavy metal content of non-polluted natural waters.

## REFERENCES

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## SAŽETAK

## Univerzalna voltametrijska ćelija

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Opisana je univerzalna ćelija prikladna za elektrokemijska mjerenja koja ima posebnih prednosti za voltametriju s akumulacijom. U njoj se mogu koristiti razni tipovi elektroda, kao što su to: kapajuća živina elektroda i viseća živina kap, te razne stacionarne i rotirajuće elektrode. Ćelija je konstruirana tako, da se jednostavno mogu mijenjati elektrode i uzorci. Pri tom su osigurani reproducibilni hidrodinamički uvjeti i »bežumni« električni kontakt s rotirajućom elektrodom. Čaša voltametrijske ćelije može biti izrađena od polietilena, teflona, stakla, kvarca itd., što omogućuje uporabu najprikladnijeg materijala za određene vrste mjerenja.

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