UPÉ-6124 GENERAL-PURPOSE ELECTRONIC POLAROGRAPH

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There has been developed a general-purpose electronic polarograph, the UPÉ-6124, intended for the making of electrochemical investigations using qualitative and quantitative analysis. The polarograms recorded are the electrolytic cell current as a function of the magnitude of the polarizing voltage.

The polarograph set includes a measuring stand, a polarographic transducer, and a ferroresonant stabilizer. The measuring stand consists of an excitation block, a high-impedance voltmeter block, a recorder, a polarizing voltage block, and a synchronization block.

The instrument can operate in four modes: 1) in the mode of recording the average cell current for the period of the life of a drop (classical regime); 2) in the mode of recording the cell current at a fixed moment in the life of a drop (tast-regime); 3) in the mode of recording single-drop polarograms on a slowly dropping electrode (oscillographic regime); and 4) in the mode of recording single-drop polarograms on stationary electrodes.

The instrument records normal and differential curves (Fig. 1) and allows the selection of practically any degree of differentiation (Fig. 2). Polarography can be carried out in two- or three-electrode regimes. The working (polarized) electrode can be a mercury drop or stationary mercury electrode; the auxiliary electrode is the mercury bottom or a platinum electrode; and the comparison electrode is of silver chloride or calomel.

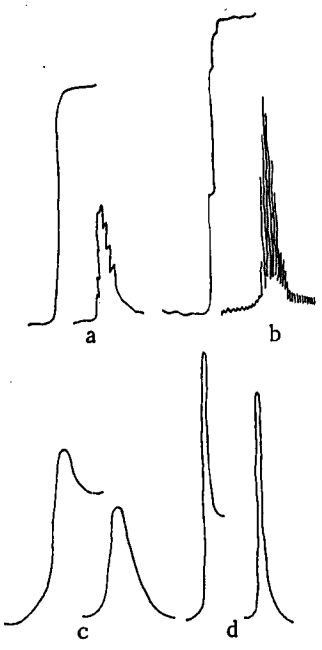

Fig. 1. Polarograms of 10^{-4} mole/liter of Cd in an ammonia background: a) classical regime; b) tast-regime; c) oscillographic regime; and d) in a stationary mercury electrode.

The initial polarizing voltage with which the recording of the polarogram waves begins may be set at any magnitude within the limits from +3 to −3 V. The accuracy of maintaining the voltage is 0.5%. The accuracy of the setting of the voltage is ±2 mV.

The instrument has two sweep directions: cathode polarization (increase of the negative potential) and anode polarization (reduction of the negative potential). The rate of linear change of the polarizing voltage may take one of the following values: 2.5; 5; 10; 20; 40; 50; 100; 200; 400; 500; 1000 mV/sec. The error in setting the sweep rate is 2% of the nominal magnitude. The allowable sweep nonlinearity does not exceed ±2%. The maximum sweep amplitude is ±3 V. In taking polarograms on one drop in the mercury drop regime, a linearly increasing voltage may be triggered automatically, synchronously with the release of the mercury drop at any instant of its life.

The sensitivity for current measurement may be set at any of following positions: 0.1; 0.2; 0.3; 0.5; 1; 2; 3; 5; 10; 20; 30; 50; 100; 200; 300; 500; 1000; 2000; 3000 μA.

Polarograms are recorded on stripchart using a recorder. There is provision for connecting to the instrument a dc oscillograph with afterglow for recording oscillograms at high sweep rates (> 100 mV sec). The setting and monitoring of the polarizing voltage is done with a high-impedance voltmeter having an accuracy of ±2 mV.

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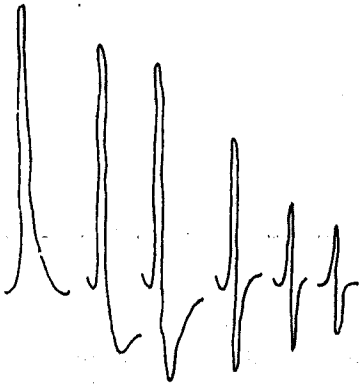

Fig. 2. Differential polarograms of 10^{-5} mole/liter of Cd, taken on a stationary mercury electrode, in an ammonia background with different degress of differentiation.

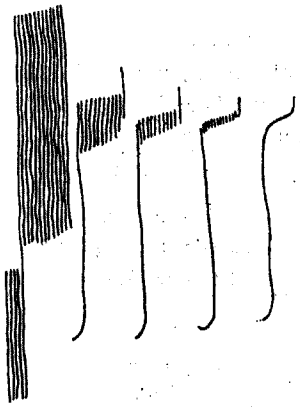

Fig. 4. Polarograms of 10^{-4} mole/liter Cd in an ammonia background for different positions of the damping switch.

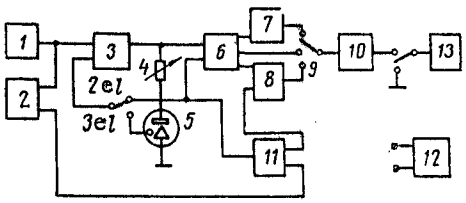

Fig. 3. Functional block diagram of the UPÉ-6124.

Figure 3 shows the polarograph functional block diagram. The total polarizing voltage from the initial voltage source 1 and the sweep generator 2 is applied through compensator 3 and measuring resistor 4 to the polarographic cell 5. The useful signal from the measuring resistor is applied to the amplifier stage 6 and into one of the channels (classical 7; tast 8, or oscillographic 9) depending on the problem. Then the signal passes to the differentiating block 10. The synchronization block 11 serves to measure the signal in the tast-regime for automatic triggering of the sweep for each drop, with the required delay relative to the beginning of the drop life in the oscillographic regime.

The synchronizer provides instrument operation in the indicated regimes for practically any background resistances. The high-impedance voltmeter block 12 is connected to the electrodes relative to which the potential measurement is made. The voltmeter input resistance is 500 mΩ. Recording of the signal is done with recorder 13 or with an additional oscillograph. The classical channel includes smoothing filters, which reduce or completely eliminate oscillations on the oscillogram caused by the growth and fall on the mercury drops. A feature of the instrument is that with an increase of the damping, the protraction of the time to take the polarograms increases insignificantly.

Figure 4 shows polarograms taken with one and the same rate of motion of the stripchart and the sweep rate, but with different degrees of damping.

The polarograph uses linear compensation of the capacitive current i_c for the classical regime, compensation of the constant magnitude of i_c in the oscillogram regime, and additional compensation of i_c in the tast-regime.

The instrument set includes an electrode of stationary mercury drops [1], thermostated electrolyzers, microelectrolyzers, electrolyzers having wearing electrodes, etc. For operation in the storage regime, there is provided a mechanical stirrer having 3000 rpm.

The UPÉ-6124 general-purpose electronic polarograph will be mass-produced in 1971 by the Gomel' Measuring Instrument Works.

LITERATURE CITED

1. S. B. Tsfasman, R. M.-F. Salikhdzhanova, S. P. Parchevskii, and M. I. Shtepa, Zavod. Lab., 32, No. 9 (1966).