

FIFTH ALL-UNION CONFERENCE ON POLAROGRAPHY

I. Orient

The Fifth All-Union Conference on Polarography was held in Kishinev from October 10-13, 1972. It was organized by the Scientific Council on Analytical Chemistry of the Academy of Sciences of the USSR, by the Institute of Chemistry of the Academy of Sciences of the MoldSSR, by the Kishinev State University, and by the Mendeleev All-Union Chemical Society. It was a jubilee conference, dedicated to the 50th anniversary of polarography. About 400 people took part (198 workers of scientific-research institutes, 193 workers from institutions of higher learning, and 17 workers from industry), who came from Moscow, Leningrad, cities of the UkrSSR, the KazSSR, the LatvSSR, and others.

A total of 413 papers was submitted with results of work carried out in the last three years (after the Fourth Conference, which was held in Alma-Ata in 1969). A system of reporter-type presentations with discussions was adopted, because the volume of information submitted made it impossible to listen to all authors of papers. The authors of submitted papers could exhibit their data on stands and give explanations.

In the plenary sessions, only review papers were read which summarized the development of the various directions of polarography. T. A. Kryukova presented a paper on 50 years' development of polarography in the USSR. Achievements in the theoretical foundation of the method and its application were discussed.

Reports by Corresponding Member of the Academy of Sciences of the KazSSR O. A. Songina, Prof. Dr. A. G. Stromberg, and Prof. Dr. A. Z. Brainina dealt with the achievements, basic directions of the work, and new possibilities in voltammetry (polarography at solid electrodes, amperometric titration, potentiometry, coulometry, etc.) and stripping polarography at mercury and solid electrodes. It was noted that inversion voltammetry of solid phases when used for a determination of the initial stage of crystallization is promising from a viewpoint of obtaining deposits with predetermined properties.

Problems of the combination of polarographic methods in inorganic-compound analysis with extraction methods, of polarography in nonaqueous media, and of the use of complexation were discussed in the report by Prof. I. V. Pyatnitski.

V. F. Toropova, E. G. Chikryzova, and B. Ya. Kaplan reported on the use of catalytic currents in analytical chemistry, on use of polarography in the study of metal complexes, and on methods of polarographic analysis with enhanced instrumental sensitivity; N. V. Nikolaeva-Fedorovich reported on the experimental and theoretical interpretation of polarographic maxima of the first, second, and third kind.

V. D. Bezuglyi gave a report which summarized the achievements of the polarographic method in studies of reaction kinetics and analysis of polymers. S. I. Zhdanov reported about polarography in organic media, discussing papers on the use of organic solvents, the purity of the base electrolyte, solvation of the cations, and proton-donating activity. Academician of the MoldSSR Yu. S. Lyalikov reported on the use of the polarographic method in industrial production control. This is most wide-spread in the determination of impurities in nonferrous metallurgy and in the analysis of semiconductor materials.

Of great interest was Ya. P. Stradyn's report on the development of the polarography of biologically active substrates such as drugs, pesticides, and growth regulants. The development of polarography in the next decades will lie precisely in its approach to biochemistry, according to the author's substantiated opinion.

All review papers are published in the book "Achievements and Perspectives of the Development of the Polarographic Method" [in Russian], Shtiintsa (1972).

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TABLE 1. Polarographic Methods for the Determination of Elements in Particular Materials

Element being determined	Method	Material	First author, place where work was done
Pd	Osc.	Coatings of Pd-V alloy	K. N. Bagdasarov, Rostov-on-Don State University
S ⁻	Ac and hf	10 ⁻⁵ - 10 ⁻² % S in Se, Cu, Ni	L. N. Vasil'eva, State Institute of Nonferrous Metallurgy
Re	IVM	Geochemical materials, pure substances, 10 ⁻⁶ to 10 ⁻⁵ % Re	A. M. Demkin, GEOKhI (Vernadskii Institute of Geochemistry and Analytical Chemistry)
Sodium dodecyl sulfate	Osc. pol.	Electrolytes	R. V. Drondina, Kishinev
Cu, Bi, Sb	Chromatopol.	Cu	A. I. Kamenev, Moscow State University
Co, Zn	Pol.	Analysis of biological materials	K. S. Cheshev, Frunze Polytechnic Institute
Systems Ce (IV)-Ce(III), Ag ammine-Ag, ferri-ferrocyanide, etc.	Amp.	Investigation of the systems in aqueous-organic media, techniques to determine organic additives	A. A. Usvyatsov, Moscow
Te	Pol. at stat. mercury elec. with programming of expt.	Semiconductor alloys	L. S. Kopanskaya, Kishinev
Hal ⁻ , CNS ⁻	Pol., dme, indirect by H of indium	In solutions of In salts	L. N. Musaeliants, Rostov-on-Don VÉIPP
Alkaline-earth metals	Pol., indir.	In the presence of Complex-one III	A. A. Usvyatsov
Pd	Catalytic currents	Ag and Pb alloys	L. S. Nadezhina, Leningrad Polytechnic Institute
Fe, Cu, Pb, Zn	Graphite el.	Tissue, blood	
Mn, Ni, Co, Fe, Si, Pd	Pol.	Manganin alloys	I. V. Aronina, Kishinev
Alkali metals	IVM	Blood plasma	V. B. Belyavskaya, Donetsk
V, Ni	Pulse pol.	Petroleum asphalts	G. K. Budnikov, Kazan' State Univ.
W	Vector pol.	Sedimentary rocks	A. G. Vas'kova, Geological Institute
Te, Zn, In	Pol.	Semiconductor materials	L. I. Veselago, Inst. of Metallurgy, Acad. Sci. USSR
O ₂		Biological materials	G. S. Ginzburg, "Red Chemist" Works
Cu, Zn, Pb	Vector pol.	Air, water	E. Kh. Gol'berg, Sanitation and Health Department, Moscow
Pb, Cu, Zn, Cd	Osc. and vector pol.	Air, biological materials	E. V. Deyanova, Inst. of Industrial Hygiene and Occupational Diseases
Pb	Pulse pol.	In Bi	B. Ya. Kaplan, State Institute of Rare Metals Industry

Table 1 (continued)

Element being determined	Method	Material	First author, place where work was done
Se	Vector pol.	Re-W-Mo alloys	The same
O ₂	Osc. pol.	Foodstuffs	B. V. Lipis, Kishinev
Cu, Pb, Cd, Zn	Osc. pol.	Nonferrous-metallurgical products	V. I. Lysenko, All-Union Scientific-Research Institute of Nonferrous Metallurgy
Cl ⁻	Ac pol.	ZnS phosphors, Ag	V. L. Maslennikov, All-Union Scientific-Research Institute of Phosphors
Sm	Hf pol.	In semiconductors	L. V. Mirovich, Kishinev
As	Pol.	In Te, Se, S, etc.	R. G. Pats, State Inst. of Nonferrous Metallurgy
Cu	Pol.	Steel, bronze, brass, Al alloys	M. M. Petropavlovskaya, "Bol'shevik" Works
Pb	Pol.		
Zn, Sn	Pol.		
Mo	Pol.	In granites	N. S. Sharipova, Kazakh State University
Ce, V	Amp.	Pig iron, alloys	V. I. Bogovina, Pipe Institute
V, Ti	Amp.	Semiconductors	V. V. Velichko, Dnepropetrovsk
Cd, Ti	Amp.	Industrial materials	E. F. Danilenko, Dnepropetrovsk
Te, Ti, Sb	Amp.	Alloys	V. A. Postnikov, Dnepropetrovsk
Ce (III) and U (IV)	Amp.	Salts of Ce, rare-earth elem.	Yu. I. Usatenko, Dnepropetrovsk
In, Cd, Pb, Ti, Zn	ASP	High-purity materials	G. A. Babich, All-Union Scientific-Research Institute of Single Crystals
Zn, Cd, Pb, Cu, Sb (10 ⁻³ -10 ⁻⁵ %)		Aluminum	É. A. Zakharova, Tomsk University
Alkali metals, alkaline-earth metals, rare-earth elements	ASP	Semiconductors	V. K. Ivanov, Tomsk Polytechnic Institute
Bi, Sb, Cu, Pb, Sn, Cd, Zn, Co, Ni	ASP	Iron	The same
Cu, Pb, Bi	ASP	Petroleum	Yu. A. Karabinov, ibid.
Cu, Bi, Sb, 10 ⁻⁶ -10 ⁻⁷ ‰	ASP		V. E. Katyukhin, ibid.
In, Ti, Pb, Cu 10 ⁻³ ‰	ASP	Phosphors	M. P. Potapov, Novosibirsk Electrotechnical Institute
Microimpurities	ASP and FSP	Oxide films	A. G. Stromberg
Te	FSP	InSb	N. F. Gridaev, Tomsk Polytechnic Institute
Cu, 10 ⁻⁷ M	FSP	Inorganic salts, petroleum	É. A. Zakharova, Tomsk University
Ag, 10 ⁻⁴ ‰	Film voltammetry	Sn, Cd, Pb	N. K. Kiva, Donetsk Institute of Commerce

Table 1 (continued)

Element being determined	Method	Material	First author, place where work was done
Au	FSP	Rocks and minerals	N. A. Kolpakova, Tomsk Polytechnic Institute
Fe, Sn	FSP	Sm-Fe alloy	A. I. Komlev, L'vov University
Sn	IVT	Ferromolybdenum	I. N. Nikulina, All-Union Scientific-Research Institute of Standard Samples and Spectral Standards
Fe, Mn, Zn, Ti	IVT	Ferrites, strontium titanate	E. M. Roizenblat, All-Union Scientific-Research Institute of Reagents for Electronics
Ce	IVT	Lanthanum oxide	L. S. Fokina, All-Union Scientific-Research Institute of Standard Samples and Spectral Standards
Pyrite, galenite	Mineral-paste elec.	Ores	L. A. Yankovskaya, Kazakh State University

Note: The method involving accumulation at solid electrodes is designated differently by the authors (FSP = film stripping polarography, IVM = inversion voltammetric method, film voltammetry). Pending the approval of a coordinated terminology we are reporting the designation given by the authors of the papers.

Hf = high frequency; ASP = anodic or amalgam stripping polarography; IVT = inversion voltammetric titration.

A query was conducted among the participants of the conference with questions about the expected future development of polarography, its various branches, fields of utilization, and the enhancement of sensitivity and reproducibility. I. M. Orient reported on data from the statistical analysis of these results, estimated the consensus of the answers, and discussed growth rate of information in the polarographic field and the dynamics of international response to its individual directions.

Scientists from other countries participated in the work of the conference. R. Kalvoda (Czechoslovakia) gave a report on the use of operational amplifiers in connection with polarography. In this way one can obtain a signal for transmission to a computer and for automatic process regulation. Kh. Shaitanov (Bulgaria) expounded a new approach to the theory of kinetic currents for the case of a fast electrode process preceded by a chemical reaction. H. Berg (GDR) discussed problems of the polarography of polymers.

Yu. A. Zolotov presented an interesting paper on the forecast development of analytical chemistry to the year 1990. Tasks were formulated concerning the increase in accuracy and sensitivity of the methods, the determination of short-lived species, remote-control methods, methods for the control of natural media, substrates of extraterrestrial origin, and biological objects. The tasks were discussed which exist in a more profound development of the theoretical and metrological principles of the methods and in development of atomic-absorption methods, methods for the quantitative measurement of ions, and others.

In parallel with the plenary sessions, discussions were held on general problems: problems of teaching and of information in analytical chemistry.

Reporter-type presentations were read and discussed in section meetings concerned with the polarography of inorganic and organic materials, polarographic instrumentation, and polarography at solid electrodes. These presentations were organized on the basis of the submitted papers, the results of which were classified in advance according to the following topics: determination of inorganic ions, analysis of industrial and natural samples, theoretical problems in the polarography of inorganic ions, investigation of complexes, electrochemistry of amalgam electrodes, and investigation of melts. In the section on polarography of organic substances, consideration was given to problems of the theory, to the investigations of nitrogen-, oxygen-, and sulfur-containing compounds, to anodic polarography, to the investigation of unsaturated and peroxide compounds, and to the analysis of industrial and biological materials. Problems of the polarography on solid electrodes and of instrumentation were separated out into individual sections and considered in reporter-type presentations. In the presentation about instruments and

experimental technique, work in three areas was discussed: new instruments and methods of investigation, polarographic sensors and facilities for sample preparation in continuous analysis, theoretical questions in the construction of instrumentation and use of high-frequency polarography for electrochemical investigations. Discussions were held on the reports: "Difference-polarographic technique of measurement with a single indicator electrode," "Universal sensor for stripping polarography," and "Sensor with automatic renewal of the working surface of a solid indicator electrode" (papers by V. E. Shevtsov, B. M. Shapiro, L. B. Babitskii, L. S. Zaretskii, and coauthors). Also discussed in this section were problems arising in the use of trapezoidally shaped alternating voltage and of phase selection with short pulses in vector polarography.

In the course of the discussion, a scheme for the classification of the voltammetric methods as proposed by A. G. Stromberg was heard. This scheme rests on 12 criteria, which are arranged into groups. It was decided to discuss nomenclature problems of the polarographic modifications at the next conference.

Singled out by the reporters as the most interesting or as papers with novel ideas were those on the concentration and determination of nanogram quantities of rhenium in the form of scarcely soluble, hydrated oxides of varying valency, on the electroreduction of persulfate anions in ethylene glycol, and on the reduction of Co, Ni, Fe, Mn, and Zn in base electrolytes of saturated chlorides and perchlorates (papers by A. M. Demkin, D. I. Dzhaparidze, G. N. Babkin, and coauthors). The role of mercury in its interaction with thiourea was investigated when using the graphite electrode; it could be shown that the quantity of mercury accumulated affects the height of the peak that indicates the concentration of thiourea and can be attributed to the formation of a compound $\text{Hg} : \text{TU} = 1 : 1$ (paper by V. I. Gorokhovskaya). The reduction of haloketones at the dropping mercury electrode was studied (L. S. Raisha Khrit). Of interest was a paper on the mechanism of electrochemical discharge and ionization of metals at the surface of an indifferent electrode (N. F. Zakharchuk and coauthors). Methods for the analysis of particular materials that were presented at the conference are disclosed in Table 1.