

Polarographic Catalytic Electro Reduction Metal Ion Complexes with Different Legend-Catalysts and Their Analytical and Physical Chemical Applications

Ya.I. Tur'yan

76 D Thurston Rd, Newton, MA 02464 USA

Corresponding Author: Ya.I. Tur'yan

ABSTRACT. Theory and experimental application of the polarographic catalytic electro reduction metal ion complexes with the object of increasing analysis sensitivity and obtaining physical chemical parameters process were carried out.

Keywords: Polarographic catalytic electro reduction, metal-ion, ligand-catalysts, physical chemical parameters, kinetic and equilibrium, adsorption.

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I. INTRODUCTION

Unlike classification metal ion complexes for polarographic catalytic electro reduction [1], [2], more generalized classification in this work was proposed: 1) "ligand", 2) oxidant ligand, 3) hydrogen ligand. These waves corresponding to process 1) have been opened by Tur'yan and Serova [3] and were named "catalytic prewaves" by Mark and Reilley [4]. As showed Kemula at all [5] in this prewave can be divided on the two prewaves.

II. CATALYTIC COMPLEXES

2.1. Metal ion and ligand catalyst

Catalytic complexes of metal ions Ni(II) and Co(II) [1] are formed by following ligands: Bandy-picolins, nicotine, pyridine thiocarbamic acids, nicotinic acid, sulfohydroxide amino acids, SCN, cysteine, rubeanic acid, glutathione, coloring matters in sugar, halogenid ions, oxalic acid, benzolpolycarbon acid, ligand in race yeast for his activity determination; for In(III) [1] – ligands: catalizator from blood cancer diseased for oncology diagnostic [6], salicylic acid; for Ga(III) [1] – ligands: p-aminosalicylic and acetylsalicylic acids; for Ti(IV): citric acid in food products, sulfosalicylic acid, pyrocatechol, pyrogallol; for Ge(IV) [1] – ligands: pyrocatechol, pyrogallol, gallate acid, gall and coloring matters and tannin in food products, chlorogen acid; for Sn(IV) [1] – ligands: pyrocatechol, pyrogallol, gallate acid, threebutyl phosphate.

The theory of electrocatalytic reaction was founded on the conception of parallel surface complexation reactions, corresponding to two prewaves [7-11]. Optimum values of the background electrolyte and ligand concentrations, pH, capillary dropping period were given in [7-11]. The discounting of the ligand adsorption was given in [12-14] and the calculating of kinetic and equilibrium parameters complexing [8, 15, 16].

2.2. Metal ion and ligand, oxidant catalyst

The double catalytic effect of ligand and oxidant established and was analyzed theoretically [17]. It allows us to decrease ligand concentration limit of determination. The general equation of catalytic oxidant current was given. It takes into account intermediate formation of associates and complex metal ions with oxidant [1].

2.3. Metal ion and ligand, hydrogen catalyst

Indicated in paragraph 2.1., the theory taking into account the availability of two parallel processes: 1) metal ions discharge from complex on condition that metal is in dissoluble in mercury, and 2) parallel reaction

of protonization the same complex, which is adsorbed on the free mercury surface with following catalytic hydrogen discharge [18-20]. This theory allows us to explain the maximum which was observed on the curve catalytic current potential and also known as feigned diffusion control at the catalytic hydrogen discharge.

III. CONCLUSION

Important advantage of proposed method is possibility obtaining of physical chemical parameters in the process of metal ion electro active complexing: 1) limiting current of the prewaves, 2) parameters of electro active ligand induced adsorption, 3) rate constants of surface and by volume electro active complexing, 4) equilibrium constants of electro active complexes formation and protonization.

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REFERENCES

- [1]. Ya.I. Tur'yan, O.E. Ruvinskii, P.M. Zaytsev. Polarographicheskaya Katalimetriya . Khimiya, Moskva, 1998, 272.
- [2]. Electrochemistry in a Divided World, Editor Fritz Sholz, Springer International Publishing, Switzerland, 2015, p.471.
- [3]. Ya.I. Tur'yan, G.F. Serova. Polarizaciya pri Polarograficheskom Issledovanii Nickel-Pyridine i Cobalt-Pyridine Kompleksov, Zhur. Fis.Khim., 31, 1957, 1976-1982.
- [4]. H. B. Mark, Ch. N. Reilley. The catalytic polarographic current of a metal complex. the nickel (II)-pyridine system, J. Electroanal. Chem., 4, 1962, 189-190.
- [5]. W. Kemula, Lj. Jeftić, Z. Galus. Electrochemical investigation of nickel-pyridine and nickel-picoline complexes, J. Electroanal. Chem., 10, 1965, 387-396.
- [6]. Ida Minevich, Yakov Tur'yan. Application of the Modified Polarographic Brdicka Method for Cancer Testing, J. Solid State Electrochem., 17, 2013, 1529-1533.
- [7]. Ya.I. Tur'yan, I.I. Moskatov. O Prirode Dvukh Polarograficheskikh Kataliticheskikh Predvoln v Sisteme Nikel Ioni-Pyridin, Zhurn. Obschey Khim., 53, 1983, 29-38.
- [8]. [8]. Ya.I. Tur'yan. Opredelenie Konstanty Kislotnoy Dissociacii Protonirovannoy Formy Liganda na Osnove Polarograficheskogo Kataliticheskogo Toka Vostanovleniya Metalla Ionov, Zhurn. Obschey Khim., 57, 1987, 431-438.
- [9]. [9]. Ya.I. Tur'yan, O.N. Malyavinskaya. Effect of the Electrical Double Layer and Pyridine Adsorption on the Catalytic Polarographic Current of Nickel(II)-Pyridine Complexes, J. Electroanal. Chem., 23, 1969, 69-80.
- [10]. Ya.I. Tur'yan, I.I. Moskatov. Polarograficheskoe Issledovanie Mekhanizma Electrosvstanovleniya Ni(II) Ion Katalizirovannoe Pyridinom I Nikotinom, Zhur. Obschey Khim., 52, 1982, 1355-1363.
- [11]. Ya.I. Tur'yan, O.E. Ruvinskiy, N.K. Strizhov. Poverkhnostnaya ili Ob'emnaya Reaktsiya Kompleksoobrazovaniya kak Promexhutochnaya Stadiya Polarigraficheskogo Vosstanovleniya Metallov Ionov pri Katalize Ligandom, Elektrokimiya, 25, 1988, 1645-1649.
- [12]. O.N. Malyavinskaya, Ya.I. Tur'yan. Vliyanie Dvoynogo Elektricheskogo Sloya i Adsorbtsiya Pyridina na Polarograficheskie Kataliticheskie Tok Pyridinovykh Kompleksov Nikelya(II) v Zavisimosti ot Potentsiala Elektroda. Elektrokimiya, 8, 1972, 836-838.
- [13]. Ya.I. Tur'yan, I.I. Moskatov. Adsorbtsiya Pyridina I Nikotina na Rtutnom Elektrode v Oblasti Izotermi Henry. Zhurn. Obschey Khim., 52, 1982, 115-120.
- [14]. Ya.I. Tur'yan, N.K. Strizhov, D.A. Khosroeva. Ligand-Inducirovannaya Adsorbtsiya v Polarografii Rodanidnykh Kompleksov India(III). Zhur. Obschey Khim., 58, 1988, 2715-2718.
- [15]. Ya.I. Tur'yan, I.I. Moskatov. Opredelenie konstant Ustoychivosti Pyridinovogo I Nikotinovogo Kompleksov Ni(II) na Osnove Polarograficheskogo Kataliticheskogo Toka. Zhurn. Obschey Khim., 51, 1981, 1412-1418.
- [16]. Ya.I. Tur'yan, D.A. Khosroeva. Tri Metoda Polarograficheskogo Opredeleniya Konstant Ustoychivosti Piridinovogo Kompleksa Nikelia(II). Zhurn. Obschey Khim., 61, 1991, 362-370.
- [17]. Ya.I. Tur'yan, E.V. Saksin. Polarograficheskie Kataliticheskie Toki pri Medlennom Obrazovanii Kompleksov s Ligandom i Regeneratsiya Metal Central Ion na Elektrode. Elektrokimiya, 7, 1971, 86-90.
- [18]. Ya.I. Tur'yan. Uravnenie Polarograficheskoy Kataliticheskoy Vodorodnoy Volni pri Odnovremennom Vosstanovlenii Ionov Metalla iz Kataliticheski Aktivnogo Kompleksa. Elektrokimiya , 8, 1972, 1227-1229.
- [19]. Ya.I. Tur'yan. O Pseudo Diffuzionnom Kontrole pri Polarograficheskom Kataliticheskom Vydelenii Vodoroda. Elektrokimiya, 13, 1977, 1422-1427.
- [20]. Ya.I. Tur'yan, Do Ngok Khue. Mekhanizm Kataliticheskogo polarograficheskogo Toka v Sisteme Co(II)-nitrit. Zhurn. Obschiy Khim., 57, 1987, 2652-2659.

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