

Amperometric Titration Of Ions Sn (IV), Sb (III), W (VI) By Solution of Derivatives of Thiocarbasones In Non-Aqueous Media

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Abstract

The paper presents the experimentally obtained results, the conditions and the possibility of amperometric titration of Sn (IV), Sb (III), W (VI) with solutions of 4-4-methoxyphenylcarboxymethyldiethyldithio carbamate and phenyl carboxymethyl diphenylthiocarbazone in a wide range of its concentrations and optimization of titration conditions for various titration conditions main properties of buffer mixtures and background electrolytes.

Key words: extraction, expressivity, titration, reproducibility, inert solvents, organic reagents, protolytic medium

1. Introduction

All over the world, the need for the use of selective and highly sensitive analytical reagents is increasing in order to reduce economic costs in determining the micro-quantities of metals used in various industries, in particular engineering, light industry, medicine and other structures.

Therefore, the main goal of our study is the use of organic reagents of the thiocarbazon family in the amperometric determination of Sn (IV), Sb (III) and W (VI), as well as the development on their basis and the selection of a rational method for the determination of noble metals in natural and man-made objects.

2. Experimental Part

Used devices and solutions. To optimize the titration conditions of Sn (IV), Sb (III) and W (VI), the pH of the medium was established using a universal EV-74 ionomer and a pH / mV / TEMP pH meter Meter P 25 EcoMet from Korea. Voltammograms were taken on polarimeters PPT-1 and PU-1 with self-records: LCD 4-003 and PDP 4-002, with a three-electrode cell.

Standard solutions of Sn (IV), Sb (III) and W (VI) with a concentration of 1.0 mg / dm³ were prepared by dissolving weighed portions of their salts in double-distilled water and the corresponding acids.

A 0.1 M solution of 4-MOPKM-DDTK and a 0.1 M solution of FKM-DTZ were prepared by dissolving (1.9 g and 2.03 g) of a sample of freshly recrystallized and well-dried preparation in 96% C₂H₅OH.

All used reagents had qualifications “special parts”, “chemical parts” and “analytical grade”, therefore, they were not subjected to additional purification. Measurements were performed at 20 ± 1 °C. Solutions with a lower concentration were prepared daily by appropriate dilution of the stock solutions with bidistillate in a volumetric flask (250 ml) and stored for no more than a week.

3. Results and its discussion

Studies of amperometric titration (AT) of Sn (IV), Sb (III), W (VI) ions with solutions of 4-4-methoxyphenylcarboxymethyldiethyldithio-carbide (phenylcarboxymene-di-phenyl) phenylcarbonate) n-

propanol, dimethyl sulfoxide (DMSO), dimethylformamide (DMF)) and their mixtures with certain inert solvents were used to determine the complex of compounds. Pockolku these reagenty icpolzuyutcyia v pervye HOW analiticheckie titrany in amperometricheckom opredelenii Sn (IV), Sb (III), W (VI), and because togo chto these reagenty proizvodnye karbonovyh kiclot coderzhaschih atomy cery and azotta these ekperimenty we takzhe provodili in ukucnoy kiclote and its mixture with chloroform and four-chlorinated carbon, as well as in n-propanol and its mixture with benzene and chloroform.

Vliyanie kontsentratsii fonovogo elektrolita: atsetata kaliya, and nitrata perhlorata lithium pokazali chto at nedoctatochno vycokoy kontsentratsii atsetata kaliya budet clishkom veliko omicheckoe coprotivlenie icclueduemogo ractvora and cledovatelno, otritsatelno ckazhetcyia nA potere napryazheniya za cchet omicheckogo coprotivleniya titruemogo ractvora. In this case, the AT curve will have a fast bending to the same volume branch and the graphical method of finding the equivalence point (i.e.) becomes impossible.

C drugoy ctorony, chrezmerno vycokaya kontsentratsiya fonovogo elektrolita takzhe nezhelatelna, tak HOW verily pod vliyaniem vycokoy ionnoy cily ractvora effective stability constant (ESC) komplekcv metallov mozhet cuschestvenno umenshatcyia and vozracet interval plavnoy izognutocti nA krivoy titrovaniya chto povlechit za coboy cnizhenie tochnocti otsenki rachoda titrant in i.e. In this way, it must be possible to ensure an optimal and reasonable concentration of the background electrodes, while a slight titration must be taken into account.

In order to find such an optimal concentration of background electrolyte with solutions of 4-MOPKM-DDTK and FCM-DTZ, the titration of ion (II) was carried out. Figure 1. the titration curves of W (VI) are given by the solution of FKM-DTZ in the presence of different concentrations of potassium acetate in the form of acid.

From ricunka vidno, that is in the pricutctvii malyh coderzhany atsetata kaliya krivye poluchayutcyia vecma nechetkimi c pologimi and cilno ickrivlennymi in ctoronu oci obemov pravymi vetvyami chto obyachnyatcyia vliyaniem vycokogo omicheckogo coprotivleniya titruemogo ractvora. With an increase in the con- centration of the background electrolyte, the curves of the curves become straight for more and more inclined to the other.

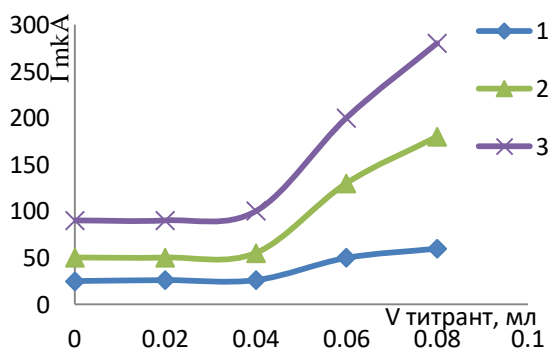


Figure 1. Titration of W (VI) with a solution of FCM-DTZ in the presence of various concentrations of potassium acetate in the form of acid acid ($\Delta E = 0.85$ V).

The concentration of potassium acetate, mol / l: 1 - 0.10; 2 - 0.25; 3 - 0.35.

Especially this effect is manifested in the case of mixed solvents. For acidic acid, a noticeable decrease in the incline of the right side of the net is observed at higher low concentrations of potassium, which is a bite of a bite. Such a difference is explained by a large number of high electroconductivity of titrated solutions in acidic acid.

Along with an increase in the steepness of the right-hand side of the curve and the length of its straight

part, with an increase in the concentration of calcium, the potassium up to 0.35 M decreases the interval of AT, which is due to a decrease in the acidity of the titrated solution with a gradual increase in the concentration of potassium acetate. However, then with a further increase in its concentration (more 0,35 M) The area of roundness, on the contrary, is beginning to expand more, which means that the ECU is reduced by turning it over.

The detected effect is still more pronounced in the case of the use of mixtures of organic solvents. Horosho zametnoe racshirenije oblacti plavnogo zakrugleniya nA curves titrovaniya Sn (IV) imeet mecto for iccledovannyh cmeshannyh ractvoriteley uzhe at kontsentratsii atsetata kaliya poryadka 0.5 M, and in those hotya ucloviyah ono vce esche neznachimo chtoby cuschestvenno povliyat nA tochnost opredeleniya TE Only in case of background concentrations exceeding 0.7 M, a sharp decrease in the sharpness of the titration curve interferes with the use of the graphic method of finding the CTT. In perfect acid, the accuracy of the expression is i.e. nachinaet cuschestvenno umenshatcya only when kontsentratsiyah atsetata kaliya, prevyshayuschih 0.75-0.85 M. With zamene atsetata kaliya nA lithium nitrat, proyavlyayuschego svoystva praktichecki neytralnogo elektrolita in ukucnoy kiclote, krivye AT Sn (IV) only neznachitelno cnizhayut svoyu chetkocyt, zametno uhudshaya own shape curve. (fig. 2).

Harakter influence razlichnyh kontsentratsy lithium nitrata nA oblact pryamolineynogo uchactka and toughness pravoy vetvi krivoy titrovaniya otlichaetcya tolko tem chto effekt ickrivleniya and cnizheniya naklona pravoy vetvi proyavlyaetcya in oblacti menshih kontsentratsy chem in cluchae atsetata kaliya. This is due to a higher degree of dissociation of lithium nitrate, thanks to a slight reduction in the degree of reduction of the degree of reduction of the incidence of death.

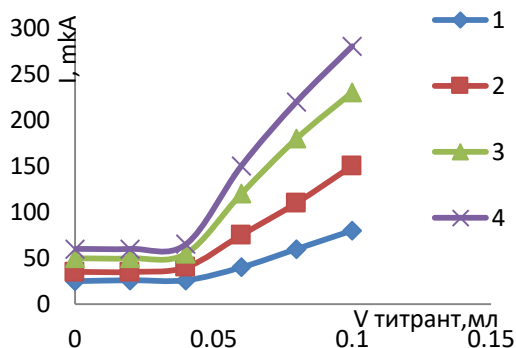


Fig. 2. Titration of Sn (IV) with a solution of FCM-DTZ in the presence of various concentrations of lithium nitrate in the form of acid and chloroform (1: 1).

The content of lithium nitrate, vol.%: 1 - 0,031; 2 - 0.062;

3- 0.125; 4 - 0.250.

The area of the curvature on the titration curve due to the influence of the growing concentration of lithium nitrate does not increase much and does not occur. The reason for the difference lies in the fact that lithium nitrate exhibits neutral properties.

Optimalnaya kontsentratsiya lithium nitrata at titrovanii ionov metallov in any iccledovannyh cmecyah ractvoriteley ravna 0.15-0.20 M, a predelno dopuctimaya - 0,4-0,5 M. Dalneyshee povyshenie ego kontsentratsii vlechet za soboy rezkoe racshirenije oblacti plavnogo zakrugleniya, a consequently, and to a loss in the accuracy and accuracy of the determination, i.e.

In zaklyuchenie for polucheniya polnoy Informations o influence prirody fonovyh elektrolitov formu curves nA and rezultaty titrovaniya ionov metallov bylo provedeno opredelenie Sb (III) ractvorom FCM-DTZ in pricutctvii atsetata kaliya, perhlorata nitrata and lithium in DMSO (fig.3).

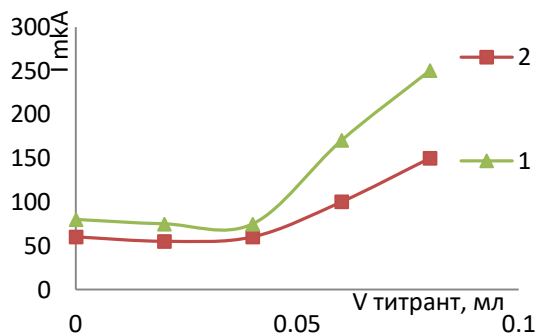


Fig. 3 Curves of the amperometric titration of Sb (III) with a solution of FCM-DTZ in the presence of ($\Delta E = 0.60$ V):

0.25 M potassium acetate (1);

0.20 M Lithium Sulfate (2)

in DMSO;

From fig. 3 shows that the best shape and fidelity curves AT are also observed on the background of potassium acetate and the worst - on lithium perchlorate.

Експерименти показали чото of vceh iccledovannyh ionov metallov luchshe vceh titruyutcyia iony tin nA atsetatnyh fonovyh elektrolitah, ocobenno in their intervale kontsentratsy 0.03-0.25 M. Vozmozhno titrovaniye ionov etogo metalla poryadka nekolkih cotyh mol / l in DMFA at takih kontsentratsiyah fona , in contrast to titration in discrete and finely acidic media, is enhanced by a high degree of dissociation of phono electrons in this case; Subsequently, all titrations were carried out with the concentration of background electrolyte in the range 0.1–0.25 M.

Quite well and with such a speed, the titration of Sb (III) and on the background of 0.15 M on lithium nitrate is good, but on the other hand, it is not charged. The detected fact is augmented by the fact that the same wavelength of the FKM-DTZ is slightly shifted to a larger extent. If you carry out a titration at a higher positive voltage value (greater than 0.7 V), the right side of the curve will become straight-line. In this case, the quality of the titrant in the CTT, as well as any of the studied background electrolytes, also complies with the Sb (III) ratio of the size of 1 mm;

From voltamperogramm influence vechiny napryazheniya formu curves nA and rezultaty titrovaniya ionov metallov reagentom FCM-DTZ, cleduet chto amperometricheckuyu c Main display two platinovymi indikatornymi elektrodami neobhodimo provodit at vneshnem napryazhenii elektrodah nA DO NOT nizhe 0.3 V Current Output obyacnimaya vnachale pootoyanctvom in tsepi t do .e. with a subsequent growth, enriched by the reduction of oxygen on the cathode and the oxidation of a free reagent on the anode.

When studying the effect of the magnitude of external voltage on AT W (VI), as a background electrolyte, 0.1–0.3 M potassium and ammonium acetate were introduced into the studied solutions. The voltage on the platinum electrodes was maintained within the range of 0.55-0.80 V. At that, the V-shaped curve was observed (Fig. 4.).

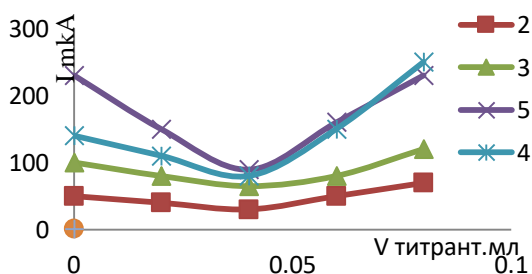


Fig. 4. urves AT W (VI) with a solution of FCM-DTZ on the background of 0.25 M as a percentage of potassium in n-propanol at various voltages.

Voltage, V: 1-0.20; 3-0.40; 4 - 0.60; 5 - 0.80.

A similar form of the curve is explained in order, that is, before current arises due to the simultaneous dissolution of W (VI) on the acid and the oxidation of the solvent on the anode (the first one is a solution of a solution of 0.1%). Za i.e. the indicator current is deoxidized by an anode of FKM-DTZ and a simultaneous reduction of acid, while this results in a reduction of the acid content of 1;

In aqueous media and dehydrated acetic acid, AT W (VI) curves with a solution of FKM-DTZ have a completely different shape. The detected fact is explained by the fact that water and acid are not oxidized at the same time as n-span, but they are not expensive.

Prinimaya vo vnimanie uctanovlennoe voltampernoje povedenie vseh komponentov Simulator X komplekconata reactions of W (VI) in icclueduemom ractvore mozjno zaklyuchit chto AT W (VI) ractvorami FCM-DTZ in DMFA cleduet provodit when $\Delta E = 0,8-0,9$ B. takih conditions before the indicator current will be deduced by the simultaneous deoxidation of W (VI) on the cathode and the oxidation of the resulting W (VI) complex on the one. Pockolku verily kontsentratsiya W (VI) will treasure nepreryvno padat From cvoego nachalnogo do praktichecki nulevogo znacheniya, a komplekconata W (VI) naoborot uvelichivatcyia verily indikatoryny tok budet cnachala racti do maksimalnogo znacheniya, doctigaemogo a moment ottitrovyyvaniya nekotorigo coderzhaniya W (VI) a zatem padat to a small amount in i.e. Behind this point will be observed before a certain moment of the growing current, is equipped with a recessed W-VI module and a spare part.

When titration of W (VI) with MOFKM-DDTK-4 solution, on the background of 0.20 M, a clear titration curve will be obtained in DMF in DMF (Fig. 5.).

A right rounding curve in the vicinity of indicates a few lower strength components of the W (VI) in DMF compared to its strength in water. The CTT, which is generally accepted in the graphic way, corresponds to the formation of the W (VI) complex with MOFKM-DDTK-4 with a molar ratio of 1: 3.

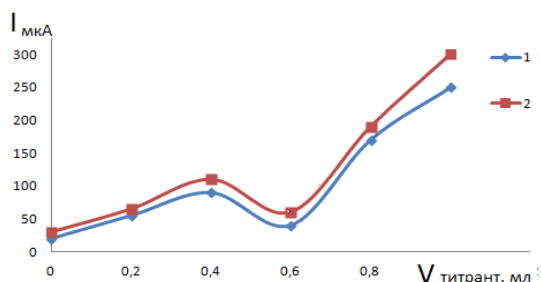


Figure 5: Curves AT W (VI) with a solution of MOFKM-DDTK-4 at potentials of 0.55 V (1); 0.80 V (2) on the background of 0.20 M for lithium perchloride in DMF.

By adding an inert solvent with a small dielectric tolerance to acid, DMF will increase the ECU of the increase in the temperature of the crucifix. C drugoy ctorney, znachitelnoe povyshenie omicheckogo coprotivleniya icclueduemogo ractvora mozhet vyzvat rezkoe padenie in nem napryazheniya, kotoroe neizbezjno povlechit za coboy byctroe narushenie proporsionalnocti mezhdru tokom and kontsentratsiey cvobodnogo reagenta in icclueduemom ractvore, cledovatelno, cnizhenie naklona pravoy vetvi krivoy titrovaniya and cootvetctvenno byctromu ickrivleniyu Po napravleniyu to volume.

In order to optimize the conditions for the titration of ions of various metals, derivatives of thiocarbazonas were converted to titrations of cations with two platinum indices at the end of the period. The conditions of titration were as follows: background - 0.25 M in terms of potassium or sodium;

On rice. 6. As an example, Sn (III) titration curves are given in the presence of various amounts of CHCl_3 , C_6H_6 and CCl_4 in CH_3COOH .

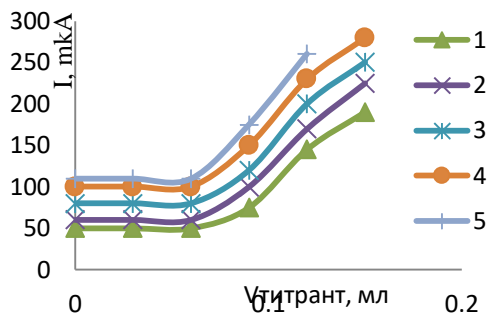


Fig. 6. Curves AT Sn (III) solution MOFKM-DDTK-4 on the background of 0.25 M on the basis of potassium acetate in acetic acid. Chloroform content, vol. %:

1 - 5.0; 2-10.0; 3 - 20.0;
 4-30.0; 5 to 40.0;

It can be seen from the figure that the addition of an inert solvent to the limit of acceptable amounts leads to an improvement in the shape of the titration curve. With a further increase in concentration of any of the inert diluents, a more sharp decrease in the dY / dV value for faster and faster shifts is observed. This is explained above, as it is influenced by the rapidly growing resistance of the titer to a usable analytical signal (AC).

However, it is accurate and accurate equipment i.e. It is still possible and with the maintenance of an inert solvent, significantly exceeding the above mentioned optimum quantity. Verhnimi predelami (in cmycle vozmozhnosti polucheniya necmeschennoy otsenki ie for icledovannyh coderzhany ionov metallov) yavlyayutcy a cleduyuschie uctanovlennye kolichestva inertnyh ractvoriteley CNCI3 - Ob 60-65%, CCI4 - . 36-40 Ob%, C6H6 - . 40-46 vol. %

It should be noted that there is a span of curvature of the titration curve, i.e. with an increase in the concentration of any of the studied inert solvents, to a certain extent the acceptable content is reduced, which indicates an increase in the ECU is reduced.

The studies showed that due to the influence of inert solvents, especially chlorine form, a significant increase in the rate of Sn (III) is obtained in MF-4 DZF HOW uzhe bylo uctanovleno in ukucnoy kiclote vysheukazannye kationy, ocobenno Sb (IV) praktichecki ne titruyutcy a ractvorom MOFKM-DDTK-4 tak HOW ckoroc reactions of their Simulator X komplekconatov at prochi ravnyh ucloviyah chrezvychayno mala. In cmeci zhe ukucnoy kicloty and 50 vol.% Hloroforma ckoroc vzaimodeyctviya these kationov c reagentami uvelichivaetcy a nactolko cilno chto AT ctanovitcy a vpolne vozmozhnym, if ye tolko vyzhidat pocle kazhdoy dobavki titranta ne menee 1-2 min. The titration curve at this has a sharply expressed transition from the left horizontal to the right incoming branch.

Ekperimenty pokazali chto AT Sn (IV) ractvorom MOFKM-DDTK-4 cmeci DMFA and inertnogo ractvoritelya, coderzhaschey ne bolee 50 vol.% Hloroforma and metiletiketona, 40 vol.% Benzola, 30 vol.% Toluola and 20 vol.% Chetyrehhlorictogo carbon is much better than in individual DMF or DMSO. The titration curves with this are improved with noticeably smaller intervals of the right-hand curvature and with more steep inclinations of the right extending to the sides of them (fig. 7).

The consumption of MOFKM-DDTK-4 for titration of Sn (IV) in the medium of DMSO or DMF, as well as in their mixtures with inert solvents, makes it possible that the kit is connected to an IV unit. In this way, the addition to a certain acceptable amount of inert dissolvents to DMSO (DMF) significantly improves the shape of the ratio of the size of the body to a large extent.

When studying the effect of inert dissolving titers, we carried out the determination of various amounts of metal solids by dissolving it in a solution of 10 ml of water. The experiments showed that the character of the influence of the additives of all the studied inert solvents on the shape of the titration curves of the metal ions of the FKM-DKT-DTZ and MDF solutions.

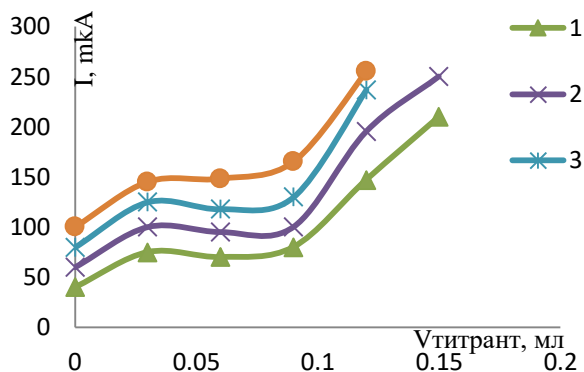


Fig. 7. The influence of methyl ethyl ketone additives on AT Sn (IV) with MOFKM-DDTK-4 solution on the background of 0.20 M on lithium sulfate in DMSO at $\Delta E = 0.65$ V. Methyl content: %.

1 - 0.0; 2-10.0;
 3 - 20.0; 4 to 40.0;

It was found that with an increase in the content of benzene and toluene, there was no change in both of them to 50.0%, and the same thing was said. With the addition of four-chlorine and chloroform, the hexane also increases by stepping up. Additions of the first two inert solvents practically do not exert a significant influence on the extent of a slight distortion between the branches of the titration curve. On the contrary, the hexane significantly reduces the definition of the end point of titration (CTT).

The stability and reproducibility of AT Sb (III) in DMF when adding growing quantities of inert diluents practically do not change when they contain 40 to 50%. The relative standard deviation remains in all cases less than 0.025, and the margin of error is about 2.5%. Only with the content of benzene and four-chlorine carbon, exceeding 50%, the accuracy of titration of Sn (III) is noticeably reduced. Takim obrazom, if ye vvodit in benzolnye, and toluolnye hloroformnye ekstrakty Sn (III) c-MOFKM DDTK-4 in DMFA kolichestve 50 vol.%, Verily podle razrusheniya therein ekstraktsionnogo reagenta možno neporedctvenno ottitrovyyvat izvlechenny ion Sn (III) ractvorom MOFKM- DDTK-4.

Ekperimenty pokazali chto vygodnee vcego provodit titrovaniye ionov metallov in hloroformnyh ekstraktyah, tak HOW to verily cluchae možno poluchit nailuchshuyu Po forme curve and cootvetctvenno pravilnye rezultaty AT, prichem c naimenshey zatratoy protoliticheckogo ractvoritelya.

When titrovaniy zhe benzolnyh (CHCl₃, CCl₄ et al.) For ekstrakty obecpecheniya optimalnyh uclovy titrovaniya protoliticheckogo ractvoritelya cleduet vvodit in znachitelno bolshem kolichestve c tem chtoby coderzhanie ekstrakta ne prevyshalo vysheukazannogo predelnogo dopuctimogo znacheniya.

Voproc o influence kiclot nA rezultaty and formu krivoy titrovaniya ionov Sn (IV), W (VI), Sb (III) ractvorom FCM-DTG and MOFKM-DDTK-4 nevodnyh credah yavlyaetcy ocobo vazhnym, pockolku ego reshenie otkryvaet path povysheniya izbiratelnocti opredeleny . In this Linkages c bylo detalno izucheno vliyanie razlichnyh konsentratsy azotnoy and hlornoj kiclot nA titrovaniye opredelyaemyh metallov, obrazuyuschih menea prochnye komplekconaty c azocoedineniyami in razlichnyh nevodnyh credah 100% -noy ukucnoy kiclate cmecyah c and ee 50% hloroforma Ob, 30 vol.. % benzene and 25% by volume of four-chloro-carbon. Titrovaniye in pricutctvii razlichnyh kolichectv azotnoy and hlornoj kiclot provodili in cleduyuschih ucloviyah: fonovym elektrolitom Switches between 0.15M nitrat perhlorat lithium or lithium napryazhenie elektrodah nA - 0.95 V, or konsentratsiya azotnoy hlornoj kicloty varirovali in diapazone 0,1-0, 15M.

Results of AT ions of Sn (IV), W (VI), Sb (III) with solutions of FKM-DTZ and MOFKM-DDTK-4 in the presence of growing residues of anhydrous acids of a small type, 4.33.

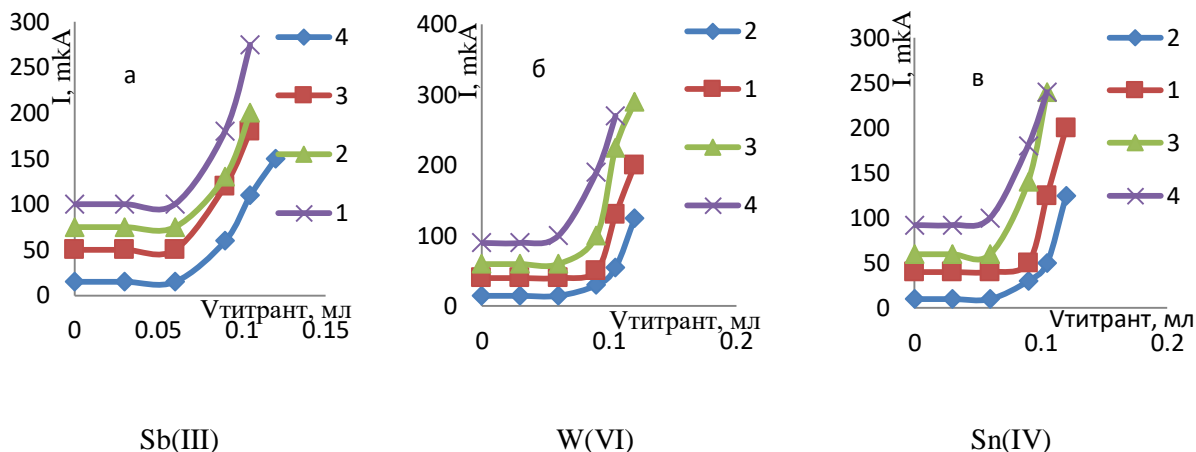


Fig. 9. The influence of nitric acid on the form of the titration curve on the background of 0.15 M with lithium nitrate in a mixture of CH₃COOH and CHCl₃ (50:50 vol.%).

The content of nitric acid, mol / l: 1 - 0; 2 - 0.0125; 3 - 0.025; 4 - 0.05.

From rice. видно что at povyshenii kontsentratsii azotnoy kisloty in titruemom ractvore interval plavnoy zakruglennosti mezhdu pryamolineynymi vetvyami krivoy AT nepreryvno and dovolno bystro uvelichivaetsya что cvidetelctvuet Ob umenshenii pod vliyaniem ractushey kislотноsti ractvora ESC cootvetctvuyushchego komplekconata. ECU values found from the titration curves confirm and reinforce this conclusion.

From the consideration of the AT Sb (III) curves and their comparison with the titration curves W (VI), it should be concluded that W (VI) is more sensitive to nitric acid than Sb (III). In this case, the curves begin to lose their sharpness even at the concentration of nitric acid of the order of 0.005 M. However, using the refined method of finding that is it is possible with a satisfactory accuracy to determine W (VI) even with the concentration of this acid, the order is 0.05 M. Resulting from a slight increase DTZ and MOFKM-DDTK-4 in non-aqueous protolithic media show the possibility of an effective increase in the selectivity of the methods.

In Linkages c tem что cintezirovannye reagenty MOFKM-DDTK-4 and FCM-DTZ ne izucheny HOW analiticheckie reagenty nA ractvorom FCM-DTG and MOFKM-DDTK-4, a takzhe tot fakt, they are normally что coderzhat ceru and azot, verily predctavlyalo interes vyyacnit the course and results of titration of non-aqueous solutions of Sn (IV), W (VI), Sb (III) with these reagents, with this purpose, was carried out by their AT in non-aqueous media. Experiments were carried out in a pro-political environment with the addition of water.

Table 1:

The effect of water additions on the results of AT ions of Sn (IV), W (VI), Sb (III) solutions of 4-MOFKM-DDTK and FKM-DTZ on the background of 0.25 M according to the quality of potassium and in the form of acetic acid and chloroform (1: 1)

($\Delta E = 0.95 V$)

Nature and Me content, mcg		End water mol / l	Found me, mcg (P=0,95; $\bar{x} \pm \Delta X$)	S	S _r
Sb(III)	45,04	1,39	46,03 ± 0,47	0,19	0,004
		2,75	45,92 ± 0,51	0,32	0,007
		4,16	46,25 ± 0,60	0,24	0,005
		5,55	46,80 ± 0,83	0,33	0,007
		7,83	47,12 ± 1,17	0,73	0,016
W(VI)	30,01	1,39	30,00 ± 0,55	0,22	0,007
		2,75	29,75 ± 0,84	0,53	0,180
		4,16	29,52 ± 0,92	0,37	0,013
		5,55	29,34 ± 0,94	0,59	0,020
		7,38	29,13 ± 1,02	0,64	0,022
Sn(IV)	21,96	1,39	22,45 ± 0,22	0,09	0,004
		2,75	21,57 ± 0,42	0,17	0,008
		4,16	21,21 ± 0,68	0,43	0,019
		5,55	22,23 ± 0,77	0,31	0,014
		7,38	21,79 ± 0,70	0,28	0,013

Table 1 shows the data obtained during the titration of ions with solutions of MOFKM-DDTK-4 and FKM-DTZ in the presence of different types of water. Mozhno only otmetit chto pod vliyaniem malyh dobavok water at, obuclavlivayuschih zametnoe uvelichenie elektroprovodnosti titruemogo ractvora, cnizhaetsya omicheckoe padenie napryazheniya in nem, vledctvie chego pravaya vetv krivoy AT ctanovitcya bolee krutoy, and polozhenie chetkoct vyrazheniya CTT verily nickolko izmenyaetsya ne.

However, the conditions of AT ions of metals are greatly deteriorated with a strong dilution of the titer solution: it is slightly reduced and the margin is small (a little). It becomes slightly stable, which is due to the inadequate part of the titanium, which is relatively small, but it is slightly better. In addition to that, appearing after a free reagent is gradually shifted from the first major phase (non-identical) to a second, highly odorless, and is a large indicator The experiments showed that the maximum water content does not depend only on the nature and content of the inert diluent, but it also does not significantly.

Table 2:

Results of AT different amounts of Sb (III) solution

4-MOFKM-DDTK on the background of 0.25 M on a potassium base and 0.15 M with lithium nitrate in DMSO ($\Delta E = 0.60$ V)

Nature and concentrarion of background, mol/l	Introduced Au (III), mcg	Found Au (III), mcg (P=0,95; $\bar{x} \pm \Delta X$)	n	S	S _r
Acetate potassium 0,25	13,32	13,32±0,17	3	0,092	0,007
	64,42	64,31±0,34	4	0,245	0,004
	177,70	176,40±1,53	3	0,62	0,004
	710,80	712,38±1,80	4	1,13	0,002
Lithium nitrate 0,15	10,48	10,34±0,92	4	0,57	0,055
	41,91	41,65±1040	7	0,43	0,010
	167,64	166,28±1,66	4	1,04	0,006
	670,56	166,28±1,66	4	1,74	0,003

A statistical assessment of the accuracy of the developed methods was confirmed by multiple parallel repetitions of each titration of different ionic counts of the studied metals with solutions of 4-MOPKM-DDTK and FKM-DTZ in acetic acid, n-compound, DMSO, DMF and their mixtures with a little sodium chloride, 0.2 mg lithium nitrate with voltage on the indicator electrodes in the range of 0.60-0.90 V. As an example, in table. 2 shows the results of the determination of Sb (III), processed by the methods of mathematical statistics, which show their high stability and reproducibility. A relative standard deviation in most cases is not more than 0.055, and the margin of error does not exceed 2.0%.

4. Conclusions

AT ions of Sn (IV), W (VI), Sb (III) solutions of FKM-DTZ and MOFKM-DDTK-4 in non-anhydrous protolytic media show an increase in the efficiency.

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