ANODIC DISSOLUTION OF TELLURIUM IN ACID SOLUTIONS*

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Abstract—The potential of tellurium anodes was measured in $HClO_4$, H_2SO_4 and HNO_3 as a function of cd and acid concentration. The results indicate the formation of telluryl ion, TeO_2H^+ , in the pH range 0–0.8, tellurous acid, H_2TeO_3 , above pH 1.8, and both products at intermediate pH. In all these solutions, the over-all reaction rate is governed by the initial discharge of water.

In non-oxidizing solutions of pH < 0 tellurium dissolves as Te^{4+} ions. Distinction between direct ionization or oxidation followed by dissolution of the oxide cannot be made. The rate-determining reaction can, accordingly, be either the first ionization step or the initial discharge of water.

Above a potential of about 0.76 V(nhe) tellurium dissolves reversibly. This behaviour is explained on the basis of a change in the molecular structure of tellurium and hence this potential is referred to as "conversion potential". Hydrogen peroxide lowers this potential.

Slow diffusion of tellurium and telluryl ions, as well as the accumulation of tellurous acid on the electrode surface, leads to a rapid potential increase at high anodic polarization.

Résumé—Mesure de la tension des anodes de tellure dans $HClO_4$, H_2SO_4 et HNO_3 , en fonction de la densité de courant et de la concentration de l'acide. Les résultats indiquent la formation de l'ion telluryle TeO_2H^+ , dans le domaine de pH 0–0,8, d'acide tellureux H_2TeO_3 au-dessus de pH 1,8 et des deux produits à des pH intermédiaires. Dans toutes ces solutions, la vitesse de la réaction globale est contrôlée par la décharge initiale de l'eau.

Pour des solutions non oxydantes à pH < 0, la tellure se dissout pour donner des ions Te⁴⁺. La distinction entre l'ionisation directe or l'oxydation suivie de la dissolution de l'oxyde n'a pu être faite. L'étape régulatrice de la vitesse peut, en conséquence, être soit celle de première ionisation soit la décharge initiale de l'eau.

Au-dessus d'une tension d'environ 0,76 V (par rapport à électrode standard à hydrogène) le tellure se dissout réversiblement. Ce comportement est expliqué sur la base d'un changement de structure moléculaire du tellure, ce qui justifie la dénomination de "potentiel de conversion". L'eau oxygénée abaisse sa valeur. La diffusion lente du tellure et des ions telluryle de même que l'accumulation de l'acide tellureux à la surface de l'électrode, conduisent à une ascension rapide de la tension aux fortes polarisations anodiques.

Zusammenfassung—Das Potential von Telluranoden in $HClO_4$, H_2SO_4 und HNO_3 wurde als Funktion der Stromdichte und der Säurekonzentration gemessen. Die Resultate weisen darauf hin, dass sich im pH-Bereich von 0–0,8 das Tellurylion, TeO_2H^+ , oberhalb pH 1,8 Tellursäure, H_2TeO_3 , und im dazwischenliegenden pH-Gebiet beide Produkte bilden. In allen verwendeten Lösungen wird die Geschwindigkeit der Gesamtreaktion durch die anfängliche Entladung von Wasser bestimmt.

In nichtoxydierenden Lösungen von pH < 0 löst sich Tellur unter Bildung des Te⁺⁴-Ions auf. Zwischen direkter Ionisation und Oxydation mit nachfolgender kann nicht unterschieden werden Auflösung des Oxyds. Dementsprechend kann entweder der erste Ionisationsschritt ober die anfängliche Entladung von Wasser die geschwindigkeitsbestimmende Reaktion darstellen.

Oberhalb eines Potentials von ungefähr 0,76 V löst sich Tellur reversibel auf. Dieses Verhalten wird erklärt durch das Auftreten einer Änderung in der molekularen Struktur des Tellurs, und das betreffende Potential wird deshalb als "Umwandlungspotential" bezeichnet. Wasserstoffperoxyd erniedrigt dieses Potential.

Langsame Diffusion der Tellur- und der Tellurylionen, sowie auch die Akkumulierung von Tellursäure auf der Elektrodenoberfläche, führen bei starker anodischer Polarisation zu einem raschen Potentialanstieg.

INTRODUCTION

ALTHOUGH the overpotential phenomena and the mechanism of the anodic dissolution of metals in the form of amalgams have been extensively investigated, fewer studies have been carried out on solid metal electrodes. In case of silver¹⁻³ overpotential has been explained on the basis of crystallization and diffusion processes. On the

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other hand, the dissolution of $zinc^4$ and $cadmium^5$ has been said to be activationcontrolled, as a result of the slow ionization of the metal atoms. In the present investigation the mechanism of the anode reactions at the tellurium electrode in acid solution is examined as a function of acid type and concentration, as well as cd. Interest in tellurium arises from its metalloid character, and from the fact that in dilute acid solutions it dissolves as telluryl ions and not as simple aquo-ions as other metals.

EXPERIMENTAL TECHNIQUE

Polarization measurements on the tellurium electrode were carried out in a cell constructed from the arsenic-free hard borosilicate glass, Hysil. The cell had the form described previously⁶ and permitted the rigorous purification of the solutions under investigation through anodic pre-electrolysis. For this purpose a platinum anode $(2 \text{ cm}^2 \text{ platinum sheet welded to a platinum wire sealed to glass) was used.}$

Spectroscopically pure tellurium rods 7 mm in diameter (Johnson and Matthey) were used; the electrodes were prepared as described earlier.⁷ The electrode area was 3 cm². Each electrode was used to trace one Tafel line only. All solutions were prepared from A.R. materials.

Before each run, the cell was cleaned with a mixture of nitric and sulphuric acids (A.R.), and thoroughly washed with conductance water. The test solution was then introduced into the pre-electrolysis compartment of the cell and pre-electrolysis was conducted at 10^{-3} - 10^{-1} A/cm² for 40 h. The tellurium electrode was then introduced in the anode compartment of the cell and adjusted to touch the Luggin capillary, which led, *via* a salt bridge, to a sce. Some of the pre-electrolysed solution was then transferred to the anode compartment, and the Tafel line was determined from low to high cd and then downwards again. After each overpotential run, the concentration of the electrolyte was determined analytically.

All measurements were carried out in an air thermostat kept at $30 \pm 0.5^{\circ}$ C. The cd was calculated using the apparent surface area. All potentials are recorded on the normal hydrogen scale.

RESULTS

The potential of the tellurium anode was measured in 0.1-4.5 N HClO₄, 0.01-5 N HNO₃ and 0.05-20 N H₂SO₄ within the cd range 10^{-6} - 10^{-2} A/cm². At any cd the potential was constant within few minutes. In each solution, six Tafel lines (on six new electrodes and solutions) were measured; the results were reproducible to ± 10 mV. Mean Tafel lines in the different solutions are shown in Figs. 1-3. Except in 2-5 N HNO₃ and 20 N H₂SO₄, the Tafel lines exhibited a linear logarithmic part. The mean values of the slopes of these parts, in mV, are given in Table 1.

At very low cd the anode potential did not change significantly, and a quasistationary potential was measured in each of these solutions. Stationary potentials were also measured for as low concentrations as 0.001 N HNO_3 and $0.01 \text{ N H}_2\text{SO}_4$ solutions. These values are similarly included in Table 1, together with the pH values of the different solutions.

Figure 4 is a plot of the stationary potentials as a function of the pH value of the solutions. The dotted lines represent the theoretical potential/pH relations of some oxidation reactions of tellurium. These are drawn on the basis that the potential varies with pH by the same gradient as that for the hydrogen electrode, viz 60 mV at 30°C, except for the Te/TeO₂H^{\oplus} system, in which case the gradient is 45 mV. It is



FIG. 1. Tafel lines for tellurium anodes in HClO₄ solutions.

clear that within the pH range 0-3 the potentials obtained in different acids follow one and the same curve, whereas below pH 0 each acid exhibits a characteristic behaviour.

Figure 5 shows the relation between overpotential η (difference between the potential at a given cd and the stationary value), and cd at low polarization in 1 N HClO₄, 1 N HNO₃ and 5 N H₂SO₄ solutions. The slopes of such relations, together with the exchange currents, i_0 , for the different Tafel lines are given in Table 2. This table contains also values for the electron number, λ , calculated from the equation

$$\lambda = rac{RT}{i_0 F} \left(\partial i / \partial \eta
ight)_{\eta
ightarrow 0}.$$

DISCUSSION

The $E/\log i$ curves obtained in the different acid solutions exhibit a region of a stationary potential at low anodic polarization. These stationary potentials represent, or at least closely approach, the reversible potential for the reaction taking place at the anode. In order to define the nature of this reaction, comparison is made between the experimentally observed potentials and the theoretical values for all possible reactions involving tellurium in acid solutions. The following oxidation reactions have been suggested as being the most probable to occur on the surface of the tellurium anode,

$$Te + 2H_2O \longrightarrow TeO_2 + 4H^+ + 4e, \qquad (1)$$

$$Te + 2H_2O \longrightarrow TeO_2H^+ + 3H^+ + 4e, \qquad (2)$$

$$Te + 6H_2O \longrightarrow H_6TeO_6 + 6H^+ + 6e.$$
(3)



FIG. 2. Tafel lines for tellurium anodes in HNO₃ solutions.

From the standard free energy of formation of TeO_2 , TeO_2H^+ , H_6TeO_6 and H_2O^8 , the standard potentials, E° , of the above reactions and for oxygen evolution, at unit H⁺ ion activity, are as follows:

	E^{-} (at 25°C)
System	V(nhe)
Te/TeO_2	0.529
Te/TeO ₂ H ⁺	0.559
Te/H ₆ TeO ₆	0.693
O ₂ /H ₂ O	1.229.

Since the standard potentials are little affected by temperature,⁹ the above values may be taken as the standard potentials at 30°C. As is seen from Fig. 4, the experimental values are not described by a single electrode reaction all over the pH range studied. Within the range 0–0.8 the values coincide almost exactly with that of the Te/TeO₂H⁺ system. In sulphuric acid solutions, this line can be extended to the point of the 10 N solution, which corresponds to pH ca –0.8. In the range 0.8–1.8 the potentials are little dependent on pH; while above pH 1.8 the values fall on straight line with a slope of 57 mV/pH and correspond, therefore, to a redox system with a standard potential of ca 0.610 V. This value does not correspond to any of the above mentioned systems, but can be readily accounted for if it is assumed that the metahydrate form of the dioxide, H₂TeO₃, forms during the anodic polarization. The anode



 TABLE 1. MEAN TAFEL SLOPES AND STATIONARY POTENTIALS FOR TELLURIUM

 ELECTRODES IN DIFFERENT SOLUTIONS

	Conc			Stationary potential
Acid	N	pH	Slope	V(nhe)
HClO	4.5	-0.95	106	0.572
	1	-0.02	105	0.560
	0.1	1.05	118	0.525
HNO ₃	5	-0·75		0.865
-	2	-0.50		0.765
	1	0.14	130	0.553
	0.1	1.10	120	0.524
	0.01	2.05	122	0.495
	0.003	2.45		0.468
	0.001	2.95		0.454
H ₂ SO ₄	20	-1.65		0.730
	10	-0.81	127	0.590
	5	0.00	147	0.560
	2	0.61		0-533
	1	0.88	160	0.526
	0.5	1.11		0.520
	0.1	1.58	153	0.515
	0.02	1.75	145	0.510
	0.01	2.20		0.490

reaction can, accordingly, be represented as

$$Te + 3H_2O \longrightarrow H_2TeO_3 + 4H^+ + 4e.$$
 (4)

According to Kasarnowsky⁸ the free energy of the reaction

$$TeO_2 + H_2O \longrightarrow H_2TeO_3$$
 (5)

is 5.55 Kcal/mole, and hence the free energy of formation of H_2TeO_3 is -115.7 Kcal/mole, which gives for reaction (4) a standard potential of 0.589 V, in fair agreement



FIG. 4. Effect of pH on the reversible potential of tellurium anodes.

with that obtained experimentally. Fron this discussion it is concluded that (i) within the pH range 0–0.8 the anode reaction corresponds to reaction (2), (ii) above pH 1.8 the anode reaction can be represented by (4), and (iii) within the pH range 0.8-1.8 the electrode potential is practically independent of pH and represents, most probably, the transition from the one reaction to the other.

Due to its amphoteric properties, H_2TeO_3 can be removed from the electrode surface through the chemical action of H⁺ ions, according to

$$H_2 TeO_3 + H^+ \longrightarrow TeO_2 H^+ + H_2 O, \qquad (6)$$

with the result that the electrode remains almost active. However, the sluggishness of the chemical dissolution of H_2TeO_3 in solutions of pH value higher than 2 made it difficult to measure Tafel lines in such solutions, and hence only the stationary potentials were recorded.



FIG. 5. Relation between cd and overpotential at low anodic polarization of tellurium.

Acid	Conc N	<i>i</i> ₀ (A/cm²)	$(\partial \eta / \partial i)_{\eta \to 0}$ V/A/cm ²	λ
HCIO	4.5	3·5 × 10-6	$6.0 imes 10^{8}$	1.25
-	1	$2.0 imes10^{-6}$	$10.2 imes 10^{3}$	1.30
	0.1	$1.4 imes10^{-6}$	15.0×10^{3}	1.24
HNO ₈	1	$4.0 imes 10^{-6}$	6.5×10^{3}	1.00
·	0.1	$2.6 imes10^{-6}$	$9.5 imes 10^{3}$	1.06
	0-01	$2.5 imes10^{-6}$	10.8×10^3	0.97
H _s SO ₄	10	1.0×10^{-5}	$3\cdot3 imes 10^{3}$	0.80
	5	$8.7 imes10^{-6}$	$3.5 imes 10^{3}$	0.86
	1	6.3×10^{-6}	4.8×10^{8}	0.86
	0.1	$6.0 imes10^{-6}$	$6.0 imes 10^{3}$	0.73
	0.20	$5.7 imes10^{-6}$	$6.0 imes 10^{3}$	0.77

Table 2. Exchange currents, $(\partial \eta / \partial i)_{\eta \to 0}$ and electron numbers for tellurium electrodes in different solutions

In solutions of fairly concentrated acids, *ie*, at pH values less than zero, the electrode potential deviates again from the theoretical relation of the Te/TeO₂H⁺ couple; and the deviation depends upon the nature of the acid. In HClO₄ solutions the potential tends to less positive values, and approaches a constant potential of 0.570 V(nhe) in 4.5 N solution. This value is in good agreement with that of the normal potential of the system Te/Te⁴⁺ given by Getmann,¹⁰ viz 0.5682 V.

Accordingly, the anode reaction in concentrated $HClO_4$ solutions can be represented

$$Te \longrightarrow Te^{4+} + 4e.$$
 (7)

In case of HNO₃ the potential increases rapidly with the acid concentration, and a value of 0.86 V is measured in 5 N solution. Such behaviour is most probably related to the oxidizing properties of this acid and/or the nitrogen oxides resulting from its reduction. A number of redox reactions are likely to be operative and involve the oxidation of tellurium into TeO₂ (E° , 0.529 V), the oxidation of TeO₂ to TeO₃ or H₆TeO₆ (E° , 1.02 V), the reduction of HNO₃ to NO₂ (E° , 0.8 V) and the reduction of NO₂ to NO (E° , 1.03 V). Accordingly, the electrode would assume a mixed potential rather than a simple thermodynamic one. In reality the anolyte was seen to aquire the brown-red colour characteristic of NO₂.

In sulphuric acid solutions, a large increase of potential was observed in case of the 20 N solution only, whereby a value of 0.73 V was obtained. This behaviour cannot be attributed to an oxidizing action of the acid, since the standard potential of H_2SO_3/SO_4^{2-} (0.17 V) is far lower than those of Te/TeO₂ and TeO₂/H₆TeO₆. The results find explanation in that persulphuric acids $(H_2S_2O_8 \text{ and } H_2SO_5)$ are formed during the process of anodic pre-electrolysis. The cd for the pre-electrolysis of the 20 N solution was 100 mA/cm²; these conditions, according to Efimow and Isgaryschew,¹¹ give efficiencies of about 40 per cent and 10 per cent for the anodic formation of $H_2S_2O_8$ and H_2SO_5 respectively. In 10 N acid only minute amounts of these peracids are expected to form. The presence of these acids, as well as of H_2O_2 resulting from their hydrolytic decomposition, is responsible for the chemical oxidation of tetravalent tellurium to the hexavalent state. The electrode again exhibits a mixed potential. These views were confirmed by measuring the stationary potentials in 10 and 20 N non-electrolysed H_2SO_4 solutions; the measured values approached the Te/Te⁴⁺ system (cf Fig. 4). Moreover, the current/potential relation obtained in 1 N H₂SO₄ that (after pre-electrolysis) was made 1 N with respect to H_2O_2 , is similar to that obtained in the 20 N solution in the absence of a linear Tafel relation (cf Fig. 3).

In 2-5 N HNO₃, 20 N H₂SO₄ and 1 N H₂SO₄ containing H₂O₂, the electrode aquired a faint reddish colour, perhaps due to tellurium trioxide TeO₃, which is known to be orange-yellow.¹²

Mechanism of the anode reaction

From the discussion above it is evident that in acid solutions having a pH value above zero, the anodic products are either H_2TeO_3 or TeO_2H^+ . The activation overpotential is, therefore, associated with reactions (4) and (2), respectively. The formation of these compounds is unlikely to occur in a single step¹³ since the reaction rate, given by

$$v = k \exp\left(\frac{4\beta\Delta\phi F}{RT}\right),\tag{8}$$

where $\Delta \phi$ is the potential difference between the electrode and the outer side of the Helmholtz double layer, would lead to a Tafel slope of 0.03 V, if β is assumed to be

0.5. This value differs markedly from those observed experimentally. Therefore, we conclude that the reaction proceeds in successive steps:

$$Te + H_2O \longrightarrow TeOH + H^+ + e, \qquad (9)$$

$$TeOH \longrightarrow TeO + H^+ + e, \qquad (10)$$

$$TeO + H_2O \longrightarrow TeOOH + H^+ + e$$
, (11)

$$TeOOH + H_2O \longrightarrow H_2TeO_3 + H^+ + e.$$
(12)

The formation of TeO_2H^+ proceeds in a similar manner except that reaction (12) is replaced by

$$TeOOH \longrightarrow TeO_2H^+ + e.$$
(13)

The observed Tafel slope for the linear logarithmic part of the curves is 0.105-0.160 V

	Conc	$E_{1/2}$
Acid	N	V(nhe)
HClO4	4.5	0.79
	1	0.78
	0.1	0.78
HNO ₁	1	0.76
-	0.1	0.74
	0.01	0.74
H ₂ SO ₄	10	0.77
	5	0.77
	1	0.77
	0.1	0.76
	0.02	0.74
	Mean	0.76

TABLE 3. HALF-WAVE POTENTIALS FOR TELLURIUM DISSOLUTION IN ACID MEDIA

(Table 1). This suggests that the rate of the over-all reaction is governed by the initial discharge of the water molecule reaction (9). This conclusion finds a support in the fact that the electron number, λ , calculated for the different solutions is very near to unity (Table 2).

The Tafel relation was found not to extend over the whole cd range studied. Thus, above $ca \ 10^{-4} \ A/cm^2$, the potential changes but slightly with the cd, exhibiting, therefore, a step which extends over about one half a log (cd) unit. Further increase in cd causes large changes in potential, and a region of a limiting cd is attained. The potentials at half these limiting cds, *ie*, the half-wave potentials, in a number of solutions, are given in Table 3.

The mean value of $E_{1/2}$ in the different solutions, 0.76 V(nhe), is ca 70 mV higher than the standard potential of Te/H₆TeO₆ system. The fact, however, that $E_{1/2}$ is practically independent of pH, disproves the probability of the direct formation of orthotelluric acid (reaction 3). The potential of this latter reaction increases by 60 mV for a ten-fold increase in the H⁺-ion activity. Moreover, the formation of H₆TeO₆ is expected to take place in successive steps, the first 4 of which are given by (9)-(12). Since the initial discharge reaction (9) is a slow process, it is unlikely that at 0.76 V it becomes a rapid one leading to the occurrence of a potential arrest. The effect of specific adsorption was further considered, since it affects the overpotential through its influence on the zeta-potential, ξ . From the Tafel slope and the electron number value, the expression for the overpotential at tellurium anodes in diluted acid solutions can be expressed

$$\eta = \text{const} + \frac{2RT}{F} \ln i - \frac{RT}{F} \ln \mathbf{H}^+ + \xi, \qquad (14)$$

where *i* is the cd. According to (14) the decrease of ξ by the adsorption of anions causes a decrease in the overpotential, whereas the adsorption of cations leads to an opposite effect. The fact that the tellurium anode exhibits the same behaviour in different acids excludes the possibility of anion specific adsorption. It can be assumed on the other hand—that H⁺ ions are initially adsorbed on the electrode surface, and tend when the potential increases to 0.76 V to be desorbed leading to a consequent decrease of the overpotential. This explanation is, however, not in agreement with the fact that in concentrated solutions the ξ -potential is small, so that the effect of specific adsorption on overpotential ought not to be observed in 1 N HClO₄, 1 N HNO₃ or 5–10 N H₂SO₄, in which cases well defined potential arrests were actually observed.

From electron-number determination for the cathodic dissolution of tellurium in alkaline solutions, the 'diatomic' nature of the electrode was suggested¹⁴ to govern its behaviour. The same suggestion accounted also for the observation that, on cathodic treatment in HCl solutions, tellurium gives two hydrides, namely hydrogen telluride, H₂Te, and hydrogen ditelluride, H₂Te₂, the standard potentials being -0.5 and -0.365 V respectively.¹⁵ Such behaviour was explained on the basis that as the potential becomes sufficiently negative, the forces binding the surface atoms are weakened to such an extent that tellurium participates in the reaction as individual atoms. It is quite possible that when made anode, tellurium again loses its 'molecular' structure when the potential becomes sufficiently positive; we suggest that the halfwave potential represents the potential required for the conversion of the tellurium surface atoms into the monoatomic state. It is further suggested that the initial discharge of water at an anode of tellurium retaining its 'molecular' state is slow, whereas under conditions permitting the monoatomic structure (*ie* at positive potentials) this reaction is fast. Thus, reaction (9) can be replaced by

$$Te_{2} + H_{2}O \longrightarrow Te_{2}OH + H^{+} + e, \qquad (15)$$

$$Te_2OH + H_2O \longrightarrow 2TeOH + H^+ + e,$$
 (16)

with (15) rate-determining. At or above the conversion potential the reaction mechanism begins with the supposedly fast reaction (9), and accordingly anodic dissolution is no longer an activated process.

In fairly concentrated solutions of non-oxidizing acids (eg 4.5 N HClO₄), the anodic reaction leads to the formation of Te⁴⁺ ions, as indicated by the stationary potentials. The Tafel slope and the electron number value suggest that this ion also forms in successive steps, the first one,

$$Te_2 \longrightarrow Te_2^+ + e,$$
 (17)

being the rate-determining. On the other hand, the ionization of the atoms at the

conversion potential,

$$Te \longrightarrow Te^+ + e,$$
 (18)

takes place rapidly as indicated by the occurrence of a potential step.

However, reaction (18) may proceed as an alternative mode of dissolution of the metal at the conversion potential in dilute solutions also, since the latter potential is appreciably higher than the reversible metal/metal-ion potential. In this case, the telluryl ion is formed through the hydrolysis of Te^{4+} ,

$$Te^{4+} + 2H_2O \longrightarrow TeO_2H^+ + 3H^+.$$
(19)

On the other hand, the similarity, below the conversion potential, between the results in 4.5 N HClO₄ and those of the dilute solutions (with regard to the general characteristics of the Tafel line) suggests the possibility that in the former solution the anode reaction follows the same mechanism as in the latter; the telluryl ion thus formed dissolves in the acid according to

$$TeO_{2}H^{+} + 3H^{+} \longrightarrow Te^{4+} + 2H_{2}O.$$
 (20)

This latter suggestion depends upon the fact that the Te/TeO_2H^+ potential is very near to that of the metal/metal-ion system. Distinction between the two alternatives cannot, however, be made.

The results obtained in 2 and 5 N HNO₃ do not give linear logarithmic parts in the cd/potential curves as in the other solutions (*cf* Fig. 2). This behaviour is expected, since the stationary potentials observed in these solutions are higher than the conversion potential, and consequently no activation process is expected. On the other hand, although in 20 N H₂SO₄ solution as well as in 1 N H₂SO₄ to which H₂O₂ was added, the stationary potentials are smaller than the conversion potential, no Tafel relations are observed. This state of affairs can be explained on the basis of the electrochemical¹⁶ and/or the catalytic¹⁷ dissociation of H₂O₂ at the metal surface. The free radicals HO₂ and OH, formed in the steps

 $H_2O_2 \longrightarrow HO_2 + H^+ + e$ (in an anodic reaction)

and

$$H_2O_2 + H^+ + e \longrightarrow OH + H_2O$$
 (in a cathodic reaction),

are chemisorbed on the surface, leading to the weakening of the interatomic forces of the metal, and the lowering of the conversion potential.

The rapid increase of potential observed in all solutions above 10^{-3} A/cm² is attributed to the slow diffusion of the anodic products (TeO₂H⁺ and/or Te⁴⁺) away from the electrode surface. This causes the onset of diffusion overpotential. Moreover, the accumulation of H₂TeO₃ on the electrode surface leads to the resistance overpotential.

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