Irreversible adsorption of alanine and serine on Pt(111) in acid medium

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INTRODUCTION.

Studies concerning to adsorption and oxidation of amino acids have been the subject of some publication [1,2]. In the present work, irreversible adsorption of alanine, serine and glycine has been carried out on Pt(111) electrodes in 0.1M $HClO_4$ solution.

EXPERIMENTAL.

The test solutions were 0.1M $HClO_4$ *Merck Suprapur* and the amino acids were from *Merck for biochemistry*. The water used for preparation of the solutions was from a Millipore-Milli Q system. All potentials are referred to the reversible hydrogen electrode (RHE) immersed in the same solution. The technique used for the isolation of the adsorbed species has been described elsewhere [3,4].

RESULTS.

Figures 1, 2 and 3 show the oxidation of residues formed in the

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adsorption of those amino acids in 0.1 M $HClO_4$ solution. In the case of alanine (fig. 1) it can be seen that the charge associated with hydrogen adsorption-desorption process is nearly complete, showing a limited presence of adsorbed species. During the sweep up to 1.16 V clear peaks related to oxidation of adsorbates cannot be distinguished. The peaks around 0.8 V and 1.1 V appear in the characteristic voltammogram for a Pt(111) electrode in the same medium. It can be observed that after three sweeps up to 1.16 V, the voltammogram is not completely restored.

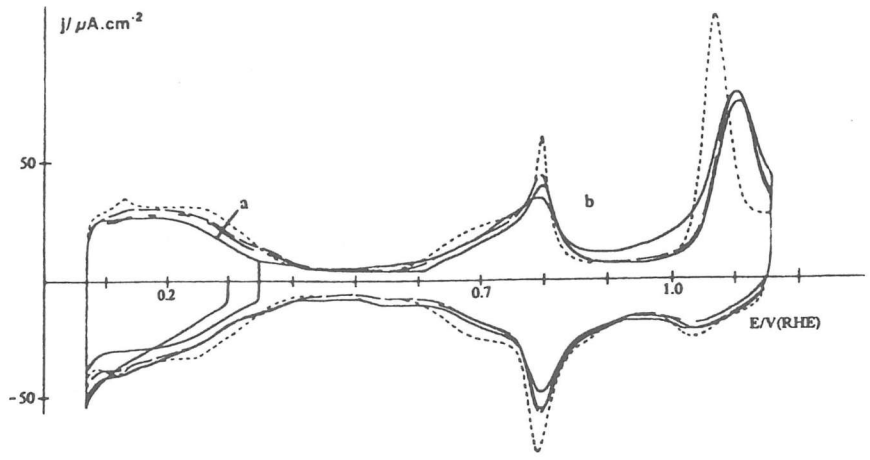

Fig. 1 Adsorption of alanine, CH_3-$CH(NH_2)$-COOH, on Pt(111) in 0.1M $HClO_4$. E_{ads}= 0.3 V. t_{ads} = 2 min.

After adsorption of serine (fig. 2) the hydrogen adsorption-desorption region, curve a, is more blocked and modified than in the case of alanine. During the first sweep up to the upper potential limit, curve b, two oxidation peaks appear at 0.58 V and 0.74 V, the oxidation peak at 0.74 V can be related to the oxidation of CO_{ads} [5]. The peaks at 0.8 V and 1.22V

are modified and shifted to more possitive potentials in relation to the characteristic ones in the test solution (fig. 2, dotted line). In the light of these facts, it would be reasonable to say that during the irreversible adsorption of serine at least two adsorbates are created: CO_{ads} which may be related to -CH_2OH group in the molecule of serine and another one that is not oxidizable at potentials below 1.22 V. The latter adsorbate could be related to the rest of the molecule of serine when the C-C bond is broken to the formation of CO_{ads}.

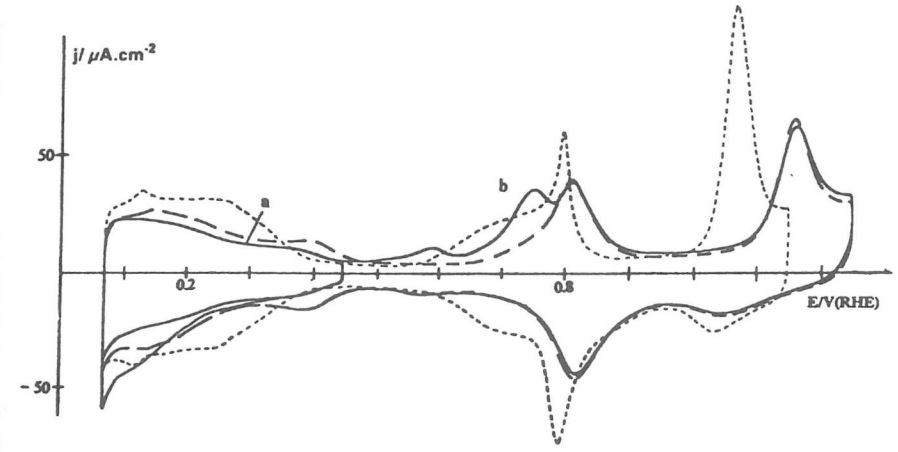

Fig. 2 Adsorption of serine, HO-CH_2-$CH(NH_2)$-COOH, on Pt(111) in 0.1M $HClO_4$. E_{ads}= 0.45 V. t_{ads} = 2 min.

Figure 3 shows the voltammetric behaviour of adsorbed residues coming from irreversible adsorption of glycine. The blocked hydrogen region (curve a) is similar to that of figure 2, but significantly differs from

figure 1. During the first sweep to the upper limit no oxidation peaks which could be associated to CO_{ads} appear in the voltammogram.

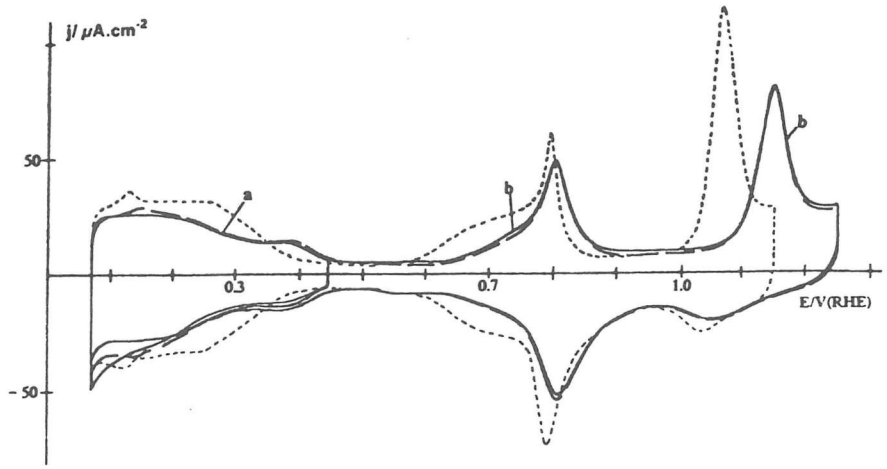

Fig. 3 Adsorption of glycine, H-CH(NH_2)-COOH, on Pt(111) in 0.1M $HClO_4$. E_{ads}= 0.45 V. t_{ads} = 2 min.

CONCLUSION.

According to the results stated above, it seems that adsorbed residues obtained from serine, after splitting of -CH_2OH bond, are of the same nature of that obtained from glycine adsorption. From the observed behaviour of alanine we conclude that during its adsorption no dissociation of the molecule takes place. The presence of methyl group in alanine modifies its behaviour and makes it different from glycine and serine.

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