

## ELECTRO-OXIDATION OF ASCORBIC ACID ON A POLYANILINE COATED ELECTRODE

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**ABSTRACT.** The results presented in this paper describe the electrochemistry of ascorbic acid on electro-oxidation of the latter on a polyaniline (PAN) - coated carbon electrode. The data obtained suggest that the PAN does not electrocatalyze ascorbic acid oxidation.

### INTRODUCTION

The importance of organic electronic conductors continues unabated as more applications for these novel materials unravel. Chemically modified electrodes have been applied in several facets of chemical research. This includes electrocatalysis which ordinarily entail mediation of electron transfer between the electrode and some substrate by the immobilized oxidation/reduction couple, reactions which will be very slow in naked or bare electrodes (1).

In this paper, the electro-oxidation of ascorbic acid on a PAN-coated electrode and the effect of film thickness on the oxidation potential of the ascorbic acid is investigated.

### EXPERIMENTAL SECTION

The electrochemical instruments used were basically the same as those discussed in reference (2). PAN-coated carbon graphite, saturated calomel electrode (SCE) and platinum wire were used as the working, reference, and auxiliary electrodes respectively. Reagent grade acids (Aldrich) and ascorbic acid (Howse McGeorge) were used as received. Aniline was triply distilled until a colorless liquid was obtained. All the solutions were prepared using triply distilled water.

### RESULTS AND DISCUSSION

The cyclic voltammogram shown in Fig. 1 was obtained on cycling the potential from -0.2 V to 0.5 V in the growth solution containing 0.1 M aniline and 1.0 M sulfuric acid. We observe the PAN oxidation and reduction peaks at approximately 0.20 V and 0.10 V respectively. Characteristics and properties of PAN redox waves have been described in detail by several researchers (2-4). The film in Fig. 1, curve A was then transferred to a solution containing 0.1 M ascorbic acid (Fig. 1, curve B), and the potential was cycled from -0.2 V

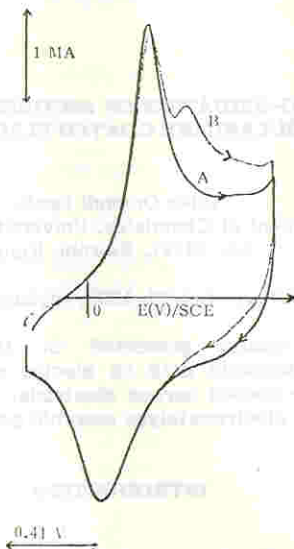


Fig. 1. PAN redox waves obtained on cycling the potential in a solution containing 0.1 M aniline and 1.0 M sulfuric acid, from  $-0.2$  V to  $0.60$  V. (Curve A). Curve B represents the cyclic voltammogram obtained on transferring the film shown in curve A, to a solution containing 0.1 M ascorbic acid and 1.0 M sulfuric acid. Scan rate, 50 mV/sec.

to  $0.7$  V. We observe an oxidation peak at about  $0.32$  V (see curve A, Fig. 1). This peak can be attributed to the oxidation of ascorbic acid. Other researchers (5,6) have observed a similar peak for the oxidation of ascorbic acid at  $0.42$  V (versus NHE). In our case the oxidation peak occurs at  $0.32$  V (versus SCE) on a bare carbon electrode. Clearly the oxidation potential is unchanged by the polyaniline coating on the electrode surface. A study was also conducted to ascertain whether there is any evidence of surface catalyzed reaction. This was achieved by monitoring the ascorbic acid oxidative peak current for PAN film of varying thickness (see Table 1). It is important to mention that the

Table 1. The variation of ascorbic acid oxidative peak current with PAN film thickness.

$i_p$ (PAN), mA	$i_p$ (Asc), mA
2.50	0.35
2.95	0.25
3.25	0.20
3.90	0.15
4.20	0.12

PAN oxidative peak current is proportional to the film thickness. The results show that the ascorbic acid oxidative peak current decreases with increasing film thickness. It is also observed that the oxidative potential is not affected

significantly as the amount of PAN film on the electrode surface is increased. These results suggest that the PAN film does not electro-catalyze oxidation of ascorbic acid.

It is also important to mention that, when the potential is held at the reduction end, i.e.,  $-0.2$  V, for several minutes and then cycled between the specified potential limit, we observe a significant build-up in the ascorbic acid oxidation peak. There is also a slight increase in the polyaniline oxidation peak. This increase in the PAN oxidative peak current has previously been attributed to the solvent content in the film (4). It is possible that the solvent also influences the oxidation of the ascorbic acid in the same manner.

### CONCLUSION

The results discussed in this paper are currently playing a pivotal role in attempts to study the changes in the porosity of PAN film. The role of the solvent in electron transfer is also currently under study. All these factors can alter the conductivity of these films substantially.

### REFERENCES

1. R.W. Murray, in "Electroanalytical Chemistry" Vol 13, A.J. Bard, Ed., M. Dekker, New York (1984).
2. D.O. Orata, Bull. Chem. Soc. Ethiop., **3**(1), 41 (1989).
3. D.O. Orata and D.A. Buttry, J. Am. Chem. Soc., **109**, 3574 (1987) and references therein.
4. A.G. Mac Diarmid, J. Chiang, M. Halpern, W. Huang, S. Mu, N.L. Somasiri, W. Wu, S.I. Yaniger, Mol. Cryst. Liq. Cryst. **121**, 173 (1985).
5. A.J. Bard, Ed., 'Encyclopedia of the Electrochemistry', of the elements', Vol. 12, p. 7, M. Dekker, New York (1978).
6. P.W. Geno et al, J. Electroanal. Chem., 183 (1985).