

## Note

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### Behaviour of silver-silver malonate and silver-silver succinate electrodes in aqueous media

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The silver-silver oxalate electrode has been employed by many workers<sup>1-3</sup> in aqueous media as the second order reference electrode, but no work seems to have been done so far on the study of the behaviour of silver-silver malonate and silver-silver succinate electrodes. The present work deals with the study of these electrodes in ionic equilibria of malonate and succinate ions in aqueous media. These electrodes, in conjunction with a saturated calomel electrode, have been employed in the potentiometric determination of malonate and succinate ions in aqueous media. In addition, the effect of the added salts, such as, potassium nitrate and sucrose on the behaviour of these electrodes has also been examined in this media.

#### EXPERIMENTAL

Silver malonate and silver succinate were prepared by adding silver nitrate solution (0.2 M) slowly to equal volumes of sodium salt solutions (0.11 M) of the corresponding acid. The precipitates formed were carefully washed by decantation with conductivity water and stored in amber-coloured glass-stoppered bottles for subsequent use.

Silver oxide was prepared by the method described elsewhere<sup>4</sup>.

Silver-silver malonate and silver-silver succinate electrodes were prepared by the method similar to that of the silver-silver oxalate electrode<sup>5</sup>. The electrode bases were of platinum-wire (No. 24-26 gage), fused into a glass tube. Electrical contact was made with the electrode by means of a copper wire dipping into mercury contained inside the glass tube. The electrode bases were first cleaned with 50% aqua-regia. The silver-silver malonate and the silver-silver succinate electrodes were then obtained by first giving these bases a coating of silver by means of thermal decomposition of silver oxide on them, and then applying to these a coating of the corresponding silver salt, i.e., malonate or succinate. After preparation, the electrodes were stored in a 0.05 M aqueous solution of the corresponding sodium salt for about 24 h and then rinsed with the conductivity water before use.

Saturated calomel electrode and the potassium nitrate-agar salt bridge were prepared in the usual process. The cell vessels were of the design as used generally in the potentiometric titration. The potentiometric titration was carried out by adding a standard solution of silver nitrate from a calibrated microburette into the vessel serving as the silver-silver malonate or the silver-silver succinate electrode half-cell, containing a known amount of the sodium salt solution of the corresponding acid with or without the presence of the added salt, such as, potassium nitrate and sucrose. After each addition of a certain volume of silver nitrate solution to the cell vessel containing sodium salt solution, the mixed solution was thoroughly stirred and the e.m.f. reading was taken by the help of a potentiometer.

#### RESULTS AND DISCUSSION

A typical potentiometric titration run for the silver-silver succinate electrode is shown in Fig. 1. Similar runs were obtained for each titration.

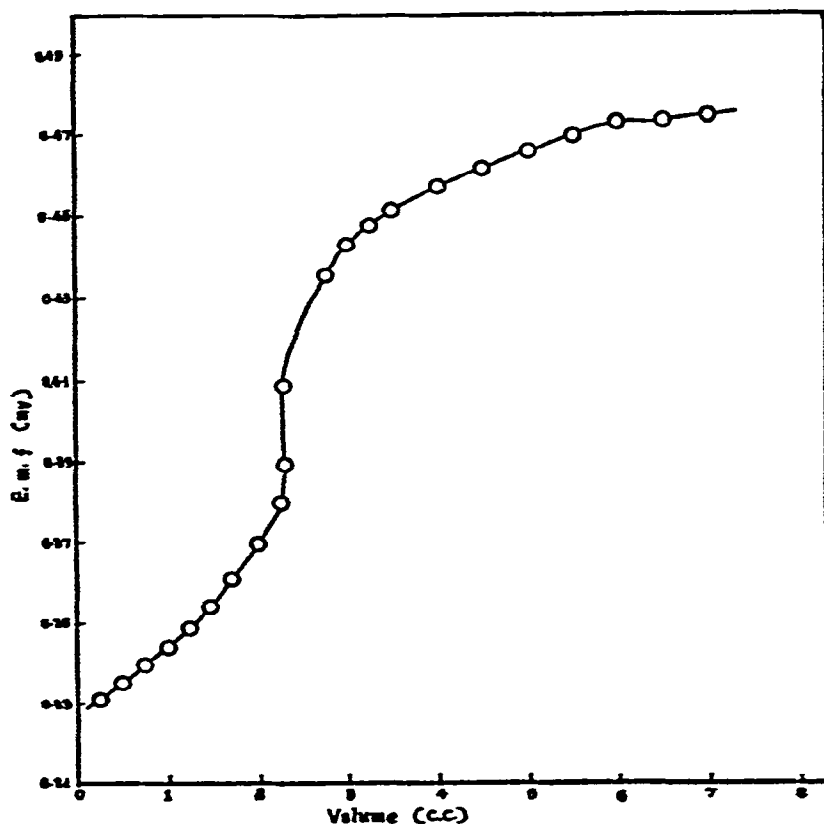


Fig. 1. Potentiometric titration curve for the estimation of succinate.

The amounts of sodium malonate and sodium succinate obtained from the potentiometric titration are presented in Table 1 along with that taken for the titration.

It is observed that the amounts of the sodium salts taken and found from the titrations are in good agreement with each other. The results suggest that the silver-silver malonate and the silver-silver succinate electrodes behave as satisfactory reversible electrode systems in aqueous media even in the presence of the added salts.

TABLE 1  
AMOUNTS OF SODIUM MALONATE AND SUCCINATE OBTAINED FROM  
THE POTENTIOMETRIC TITRATION

<i>Sodium salt</i>	<i>Taken (mg)</i>	<i>Found (mg)</i>	<i>In presence of the added salt</i>
Malonate	38.51	38.76	—
Malonate	38.51	38.76	Potassium nitrate
Malonate	38.51	38.76	Sucrose
Succinate	19.77	19.39	—
Succinate	19.77	20.20	Potassium nitrate
Succinate	22.24	22.76	Sucrose

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