

## **E2-23: Effect of temperature on redox behaviour of polyaniline**

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Polyaniline is a conducting polymer which has an electronic conductivity at positive potentials when prepared from a solution of low pH (less than 3). The structure of the polymer can be switched repeatedly from a conducting state to a non-conducting state. The polymer backbone is positively charged when it is conducting and the polymer is then blue in colour. In contrast, the polymer is neutral when non-conducting and yellow in colour. Thus the

structure of the polymer backbone is the decisive factor in the determination of the conductivity of the polymer. The structural information on the polymer can be extracted from its redox properties.

In this communication, the redox properties of polyaniline measured at different temperatures are reported. Polyaniline was electrodeposited on a Pt disc electrode from a deoxygenated solution containing  $0.1 \text{ mol dm}^{-3} \text{ NaClO}_4$  and  $1 \text{ mmol dm}^{-3}$  aniline at pH 2 (adjusted using  $\text{HClO}_4$ ).

The cyclic voltammograms of polyaniline at low temperatures such as  $0^\circ\text{C}$ ,  $4^\circ\text{C}$  etc. were well behaved and the peaks were more or less symmetrical. The plot of  $\log |I_p|$  versus  $\log |v|$  where  $I_p$  is the peak current at the scan rate of  $v$ , had a gradient close to 0.5. This data revealed that the redox properties of polyaniline at low temperature was predominantly determined by the redox chemistry of the polymer backbone. However, the peak separation increased with increasing temperature. The cyclic voltammogram of polyaniline at high temperature ( $40^\circ\text{C}$ ) was almost featureless and the gradient of the plot of  $\log |I_p|$  versus  $\log |v|$  was close to unity indicating that the diffusion of counter ions through the solution into and out of the polymer backbone decided the redox properties of polyaniline at high temperature. These results clearly show that the cyclic voltammetric behaviour of polyaniline was complicated by the diffusion of species at high temperature. The behaviour of cyclic voltammogram of polyaniline in the same electrolyte at temperatures between 4 and  $40^\circ\text{C}$  (such as 10, 20,  $28^\circ\text{C}$ , etc.) showed mixed behaviour of the above two extremes. The gradient of the plot of  $\log |I_p|$  vs  $\log |v|$  at these temperatures was close to 0.75. Thus, information regarding the redox chemistry of the polymer can only be obtained at low temperatures when the solution species were relatively frozen.