

E2-23: Mechanism of electron transfer between Pt electrode and eugenol in acetonitrile

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Eugenol is the major constituent of oil of clove (78-98%), oil of cinnamon leaf (70-95%) and is also present in many other essential oils to a lesser extent. Eugenol belongs to the class of terpenes, and its chemical modification is not straight forward. For instance, the demethylation of 2-methoxy group of eugenol can be affected by means of potentiostatic electrosynthesis and chemical methods have not been successful. The product, in this case, is 4-allyl catechol which is a non-toxic antioxidant. This paper is based on a mechanistic study of the redox reactions of eugenol on Pt surfaces in acetonitrile medium.

Cyclic voltametric (CV) studies of eugenol in deoxygenated acetonitrile solution were carried out in a one-compartment cell consisting of a Pt-disc working electrode, a saturated calomel reference electrode and a Pt-gauze auxiliary electrode. The electrolyte was a deoxygenated acetonitrile solution containing $0.100 \text{ mol dm}^{-3} \text{ NaClO}_4$ and eugenol in millimolar quantities. Potential scanning and potentiostating the working electrode were done under a N_2 gas blanket using electrochemical analyser (Oxford Electrodes)

Cyclic voltamograms were recorded in the 'full' range of -1.5 V to $+2.4 \text{ V}$ and in 'cut' ranges -0.375 V to $+1.500 \text{ V}$ and 0.600 V to $+1.500 \text{ V}$ at 3 mmol dm^{-3} eugenol concentration. Cyclic voltamograms were also recorded as functions of eugenol concentration and scan rate.

The CV of eugenol on Pt in the above electrolyte shows one major oxidation peak and one major reduction peak centred at -1.2 V and $+0.1 \text{ V}$ respectively. The 2 peaks form a redox couple as confirmed by the 'cut' range experiments. The peak current varies linearly with eugenol concentration. The scan rate dependence of the peak positions and currents show the following characteristic features; (1)The anodic peak shifts to more positive potentials while the cathodic peak shifts to more negative potentials as the scan rate is increased, the increment being quite significant. (2)The peak current is linearly proportional to the square root of the scan rate.

These features suggest that the mechanism of electro transfer is EC, i.e. the charge transfer is followed by a chemical reaction. Bulk electrolysis of the system at the anodic peak position resulted in the formation of a dimerized product.

The electrochemistry of eugenol on Pt electrodes in acetonitrile medium is well behaved with one oxidation peak and one reduction peak in the potential range -1.5 V to $+2.4 \text{ V}$. The electron transfer occurs according to the EC mechanism. One-electron oxidation of eugenol is followed by dimerization.