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FACTORS AFFECTING THE CONDUCTIVITY OF SURFACE IMMOBILISED POLYANILINE

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Polyaniline exists in six different structural forms depending upon the extent of oxidation and protonation of the polymer backbone. One of these forms is an electronic conductor with maximum recorded conductivity of 100 S cm^{-1}. Some of these forms can be easily and quickly interconverted while the most oxidised form is prone to various chemical reactions leading to the degradation of the polymer. The extent of conductivity of the conducting form of the polymer, known as emaraldine salt, depends strongly on various parameters such as the acidity, the counter ion etc. The properties of the materials are such that innumerable possible technological applications for the material can be found. However, most of such applications depend on the processibility of the material. We have already designed and developed a method to retain polyaniline on ordinary glass surfaces. This involves the reaction of surface hydroxyl groups of glass with $SOCl_2$ followed by aniline at ca. 400 °C and subsequent deposition of polyaniline by oxidative polymerisation of aniline in aqueous acidic solution containing functionalised glass plates. This procedure ensures a permanent attachment of polyaniline on glass surfaces though the conductivity of the surface is relatively poor owing to the discontinuity of the polyaniline layer on the surface. During this project we have attempted to increase the smoothness and conductivity of the polyaniline coat attached to ordinary glass surfaces by further improving the immobilisation procedure and studying the factors affecting the conductivity of the immobilised polyaniline layer.

Ordinary silica glass surfaces contain some hydroxyl groups and Si-O-Si linkages and bound water molecules. Refluxing the glass with concentrated hydrochloric acid results in the hydrolysis of the Si-O-Si linkages to yield Si-OH groups. As such pre-cleaned glass pieces were refluxed with conc. HCl for different periods from 1 hour to 24 hours. The plates were then rinsed with water and dried. The above procedure was then followed on such glass plates. Also the effect of concentration ratio of the oxidant to the monomer and the effect of various oxidants and their concentrations were studied in order to investigate the best oxidant, optimum concentration ratio for obtaining highly conducting smooth glass plates.

Our results have clearly shown that the refulxing with conc. HCl for a minimum of 6 hour period ensures the increased amount of surface -OH groups and hence better contrast for the surface deposited polyaniline layer. Further, we found that Fe^{3+} is a better oxidant than all the other oxidants tested (6 in number ranging various redox potential values above that of aniline/aniline$^{\cdot+}$). The optimum concentration ratio is 1:6 in monomer:oxidant when Fe^{3+} was used as the oxidant. The resultant polyaniline layer is smooth to microscopic examination and has a sheet resistance of 8.5 kΩ cm^{-1}.