DEVELOPMENT OF POLYMER ELECTRODES FOR FUEL CELLS

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Electronically conducting polymers offer innumerable potential applications in various electrical and electronic devices. Poly(3,4-ethylenedioxythiophene) (PEDOT), in particular, has a combination of properties which are very unusual for polythiophenes, and potentially useful. One of the drawbacks of conjugated polymers in general is that they have very poor mechanical properties (e.g., elasticity, ductility and malleability). A way to improve mechanical properties while retaining desirable electrical properties would be to deposit the material on a polymer matrix having improved mechanical properties. Fluorocarbon polymers with grafted sulphonate groups are attractive host polymers for this purpose. Firstly, the grafted sulphonate anions could act as the anions needed to counterbalance the positive charges of the conducting form of the polymer, a strong support-film interaction might be expected. Secondly conducting polymer-grafted materials of this kind could be useful as proton exchange membranes demanded by the fuel cell technology.

For this purpose, PEDOT-grafted polyvinylidenedifluoride-g-polystyrene sulphonate (PEDOT grafted PVDF-PSSA) membranes were prepared and characterised by Electrical Conductivity measurements, Cyclic Voltammetry, Scaning Electron Microscopy (SEM), EDX (Energy Dispersive X-ray Analysis), and TEM (Transmission Electron Microscopy. Different blends were prepared by changing the monomer:oxidant:PSSA ratio and the preparation temperature to find the optimum conditions to give highly conducting amorphous material deposited on the PVDF-g-PSSA surface. Out of fifty different trials investigated PSSA:EDOT:$Fe(NO_3)_3$ = 3:5:15 (0.0300 mol dm^{-3}: 0.0500 mol dm^{-3}: 0.1500 mol dm^{-3}) at 15 ^{o}C was found to result in amorphous, non-fragile, free-standing composite material with a sheet resistance around 22 Ω cm^{-2}. The material is transparent-blue and its electrochemical responses can be investigated directly without having to use a metal support. Thus the material developed is attractive as an electrode material in the direct methanol fuel cells.