Electrospun polyetherimide-graphene oxide nanofiber electrodes for enhanced conductivity

ABSTRACT

Polyetherimide (PEI) is recognized as a potential candidate for electrochemical sensor matrix which can be used for heavy metal ion and reactive chemical substance sensing applications. However, the relatively low conductivity of PEI material limits its usage of electrochemical sensor applications. Modifying PEI membrane considerably improve the electron conductivity and electrochemical property of polymer. Conductive polyetherimide-graphene oxide (PEI-GO) composite nanofiber membrane was synthesized via electrospinning technique in order to modify electrochemical sensor electrodes. In order to optimize the electrospinning process protocol such as viscosity, surface tension and conductivity and obtained smooth electrospun fiber, PEI were electrospun from two different solvents namely n-methyl-2-pyrrolidone (NMP) and combination of NMP/ dimethylformamide (DMF). Physical and electrical properties of the nanofiber were analysed in terms of its hydrophobicity, porosity and conductivity by manipulating the concentration of PEI from 20 wt% to 30 wt% and GO loading from 0.1 wt% to 0.5 wt%. Electrospun of 25 wt% PEI in NMP/DMF produced the highest porosity and liquid uptake of 97.81% and 2846.23% respectively. The addition of GO at 0.5 wt% into 25 wt% of PEI (NMP/DMF) improved the porosity and liquid uptake up to 98.83% and 5400%,respectively, while the conductivity increases to 32.71 µS/cm which is 10 folds higher than GO free PEI fiber. When the conductivity of drop-casted PEI-GO modified electrodes was compared to the electrospun PEI-GO fiber modified electrodes, the latter showed 2-3 folds higher. Proposed PEI-GO electrospun fiber with the enhanced conductivity, porosity and hydrophobicity along with high chemical stability can be used as an efficient conductive matrix for electrochemical electrode applications such as heavy metal ion sensing and reactive chemical sensing application.