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# An ionic liquid incorporated gel polymer electrolyte for double layer capacitors

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**Abstract.** Energy storage devices have received a keen interest throughout the world due to high power consumption. A large number of research activities are being conducted on electrochemical double layer capacitors (EDLCs) because of their high power density and higher energy density. In the present study, an EDLC was fabricated using natural graphite based electrodes and ionic liquid (IL) based gel polymer electrolyte (GPE). The IL based GPE was prepared using the IL, 1-ethyl-3-methylimidazolium trifluoromethanesulfonate (1E3MITF) with the polymer poly(vinyl chloride) (PVC) and the salt magnesium trifluoromethanesulfonate ($Mg(CF_3SO_3)_2$ - MgTF). GPE was characterized by electrochemical impedance spectroscopy (EIS), DC polarization test, linear sweep voltammetry (LSV) test and cyclic voltammetry (CV) test. The maximum room temperature conductivity of the sample was $1.64 \times 10^{-4}$ $Scm^{-1}$. The electrolyte was purely an ionic conductor and the anionic contribution was prominent. Fabricated EDLC was characterized by EIS, CV and galvanostatic charge discharge (GCD) tests. CV test of the EDLC exhibits a single electrode specific capacitance of 1.44 $Fg^{-1}$ initially and GCD test gives 0.83 $Fg^{-1}$ as initial single electrode specific discharge capacitance. Moreover, a good stability was observed for prolonged cycling and the device can be used for applications with further modifications.

**Keywords:** ionic liquid; electrochemical double layer capacitor; natural graphite; gel polymer electrolyte; 1-ethyl-3-methylimidazolium trifluoromethanesulfonate

## 1. Introduction

Electrochemical double layer capacitors (EDLCs) have been recognized as attractive energy storage devices by researchers due to their high power densities and high energy densities compare to batteries and conventional capacitors (Kang *et al*. 2014). In EDLCs, there are no faradic reactions involved. Instead, the operation is based on the reversible adsorption of ions between the electrodes and the electrolyte. EDLCs are fabricated with carbon-based electrodes such as activated carbon, single-walled and multi-walled carbon nanotubes (Pandey *et al.* 2010a).

High power performance of EDLC can be achieved by the use of high conducting aqueous electrolytes. However, due to the narrow electrochemical stability window of water, these EDLCs

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