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# PVDF-g-poly (styrene-*co*-vinylbenzyl chloride) based anion exchange membrane: High salt removal efficiency and stability

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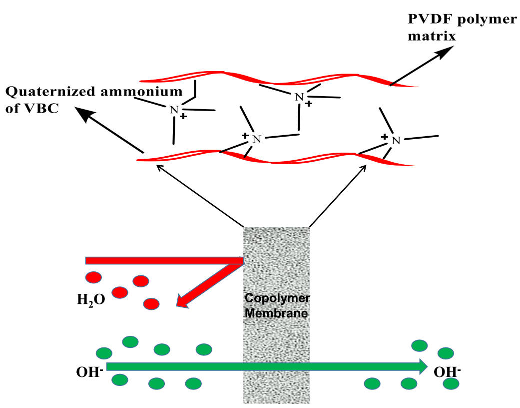
## GRAPHICAL ABSTRACT

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## ABSTRACT

Water and energy crises draw much attention towards ion exchange membranes based technology. The progress in membrane-based technology provides an effective platform to develop suitable material with superior performance for anion exchange membranes (AEMs). AEM based fuel cell technology is the most appropriate power system for portable applications. Herein we report the synthesis and application of polyvinylidene fluoride based copolymer AEMs. AEMs were synthesized by grafting poly (styrene-*co*-vinylbenzyl chloride) on unsaturated fluorinated backbone using free radical mechanism. PQSV membranes show good ion transport mechanism, having ionic conductivity of $1.24 \times 10^{-2}$ S/cm to $3.95 \times 10^{-2}$ S/cm and ion exchange capacity ranging between 0.64 and 1.36 meq/g. PQSV membranes were subjected to electrodialysis for salt removal and methanol permeability measurement for direct methanol fuel cell. Performance of PQSV membrane during salt removal was evaluated in terms of power consumption and current efficiency and found in order of 1.46–1.89 kW h/kg and 78.31–85.46%, respectively. Fuel cell applicability of PQSV membranes coined in terms of methanol permeability and PQSV membranes show high methanol crossover resistance of the order of $2.67 \times 10^{-7}$ to $6.76 \times 10^{-7}$ cm$^2$/s. Results show the PQSV membranes have a great potential for salt removal with high methanol crossover resistance with better stability.

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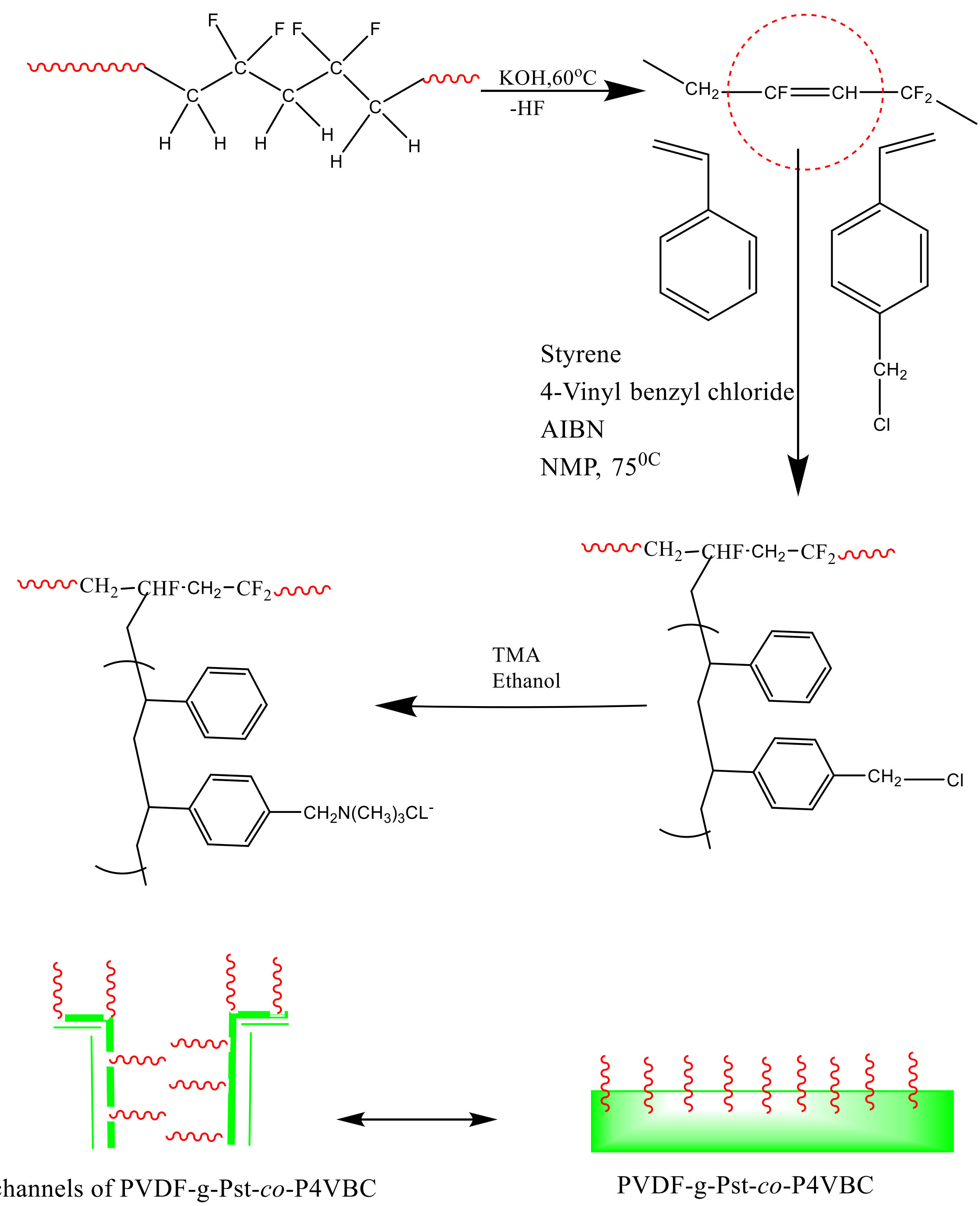
## 1. Introduction

Now days, membrane technology is showing their extreme efficiency towards numerous industrial applications such as water treatment, air purification and energy production as greener technology [1–7]. Among all ion exchange membranes (IEM) has attracted much courtesy because they are easily moveable, can be activated at low temperature also having high power density and light weight. The membrane driven technology afford clean and competent energy for movable and stationary electronics. Recently USA, Japan and China are focusing mainly on fuel cells because they are actually alternatives of the fossil fuels because of cumulative environmental pollution. The key component to solve such kind of problems is the development of ion exchange membrane, which is the heart of any electrochemical system [8–10]. As the demand increases, we require such type of ion exchange membrane that is stable either electrochemically in reducing surround at cathode and oxidative environment at anode [1,2]. IEMs are categorized in two main categories viz fluorinated and non-fluorinated. Sulfonated polyether sulfone, sulfonated polysulfone, sulfonated polybenzimidazole (PBI) and sulfonated poly(2,6-dimethyl-1,4-phenylene oxide)are the non-fluorinated type IEMs while SPVDF and SPTFE are the fluorinated type IEMs including Nafion. A complex system is also available having fluorinated and non-fluorinated type polymers. Nafion is a benchmark membrane common known fluorinated membrane used worldwide and studied extensively [11–14]. Although it has good ionic conductivity, good mechanical strength but it has several drawbacks




**Scheme 1.** Schematic representation for the synthesis of copolymer membrane.