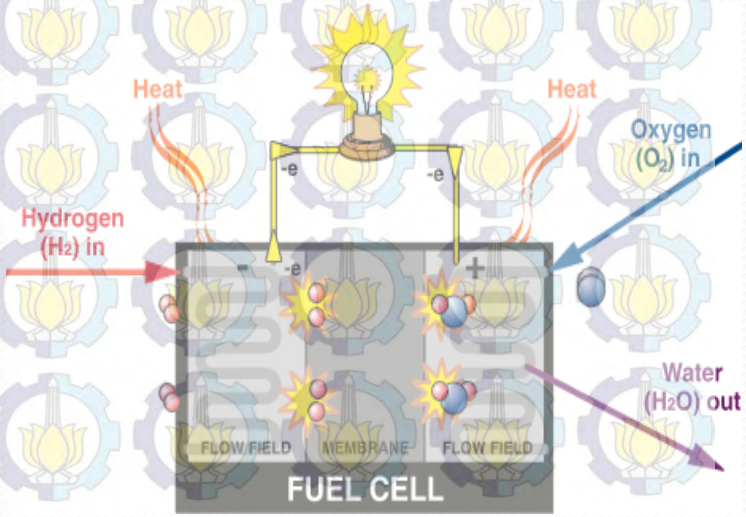
EFFECTS OF SULFOSUCCINIC ACID TO THE PERFORMANCE OF COMPOSITE MEMBRANE FOR DMFC APPLICATION

By :

MATIUS STEFANUS BATU, DIAN PERMANA & LUKMAN ATMAJA, Ph.D



DEPARTMENT OF CHEMISTRY
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
SEPULUH NOPEMBER INSTITUTE OF TECHNOLOGY
SURABAYA, INDONESIA
2015

INTRODUCTION

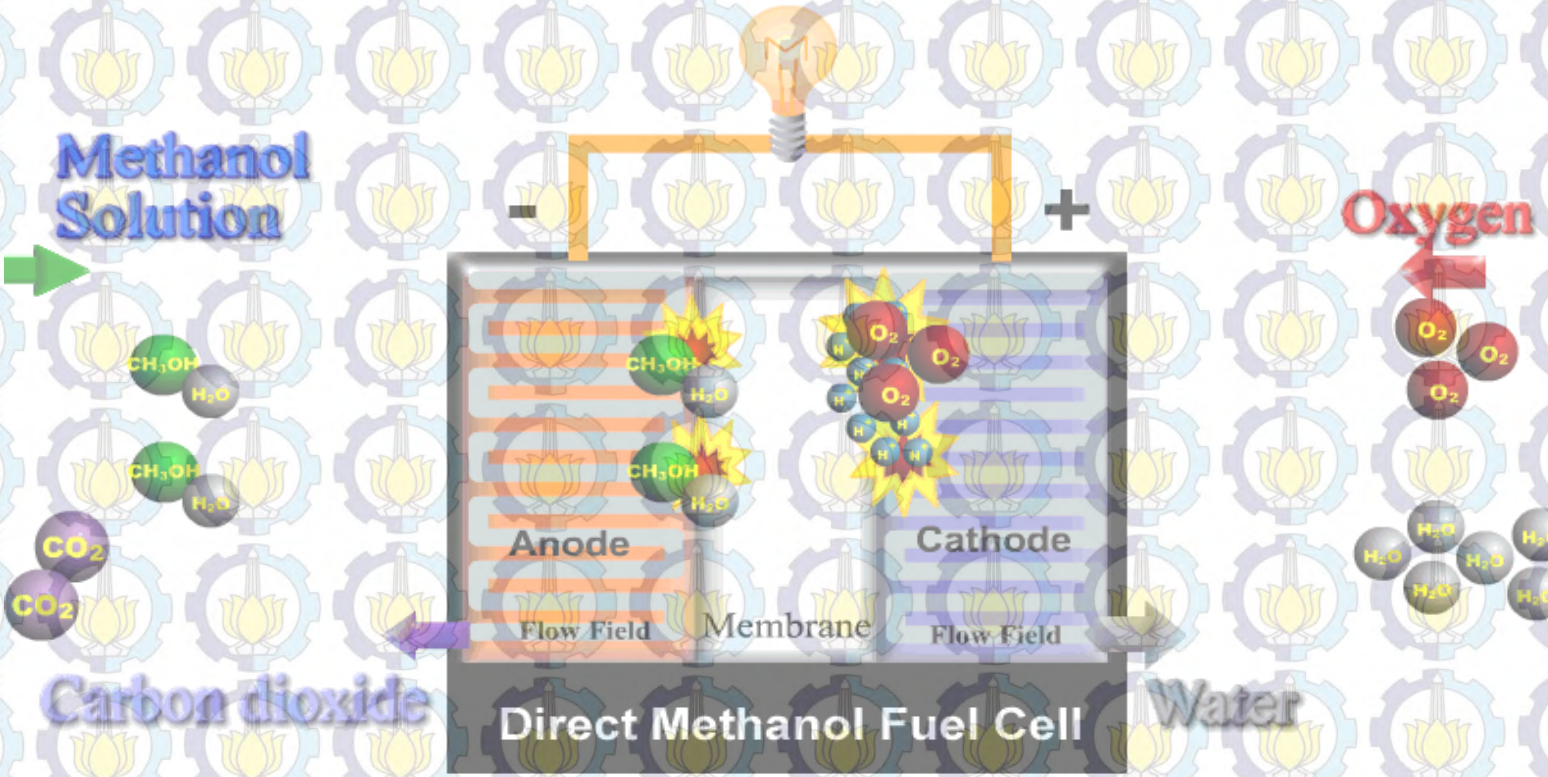
Fuel Cell

AFC | SOFC | PAFC | MCFC | PEMFC | DMFC

\- High operation temperature
Difficult to operate

\+ Low operation temperature
Easy to operate

INTRODUCTION



Overall Reaction at Anode

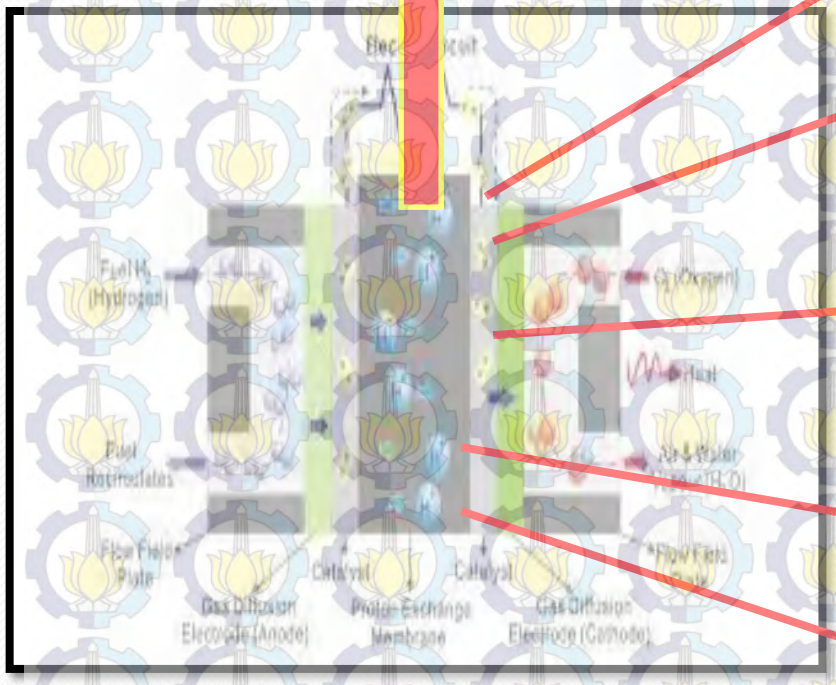
$$CH_3OH + H_2O \rightarrow CO_2 + 6e^- + 6H^+$$

Overall Reaction at Cathode

$$3/2O_2 + 6e^- + 6H^+ \rightarrow 3H_2O$$

INTRODUCTION

Electrolyte Membrane



- Low methanol permeability
- High proton conductivity
- Can operate at high temperature (> 100˚C)
- Cheap prize
- Good Chemical Stability

INTRODUCTION

Electrolyte Membrane

Nafion®

+
- High proton conductivity
- Good chemical stability

-
- High methanol permeability
- Can not operate at high temperature
- Expensive and not eco-friendly

Chitosan

+
- Low metanol permeability
- Easy to synthesis and eco-friendly
- Good chemical stability

-
- Can not operate at high temperature
- Proton conductivity is lower than Nafion®, but still possible to modify

INTRODUCTION

Can not operate at high temperature

Proton conductivity lower than Nafion®, but still possible to modify

Modification

EXPERIMENTAL

Synthesis and Characterization of Composite Membrane

Kitosan (CS)

dissolves in 75 ml of acetic acid solution 2% (65°C)

Montmorillonite (MMT)

dissolves in 25 ml of acetic acid solution 2%

Sonication 30 min

- Stirred at 65°C for 30 min
- Sonication for 30 min
- Added Sulfosuccinic acid (SSA)*
- Stirred at 25 °C for 6 hour
- Cast onto dry glass plate
- Dried at room temperature

*)

Membrane	CS (g)	SSA (g)
CS/MMT/SSA 0%	2,0	0.00
CS/MMT/SSA 4%	2,0	0.08
CS/MMT/SSA 8%	2,0	0.16
CS/MMT/SSA 12%	2.0	0.24
CS/MMT/SSA 16%	2.0	0.32

Membrane

- Neutralized with NaOH
- Washed by Aqua DM
- Dried at room temperature

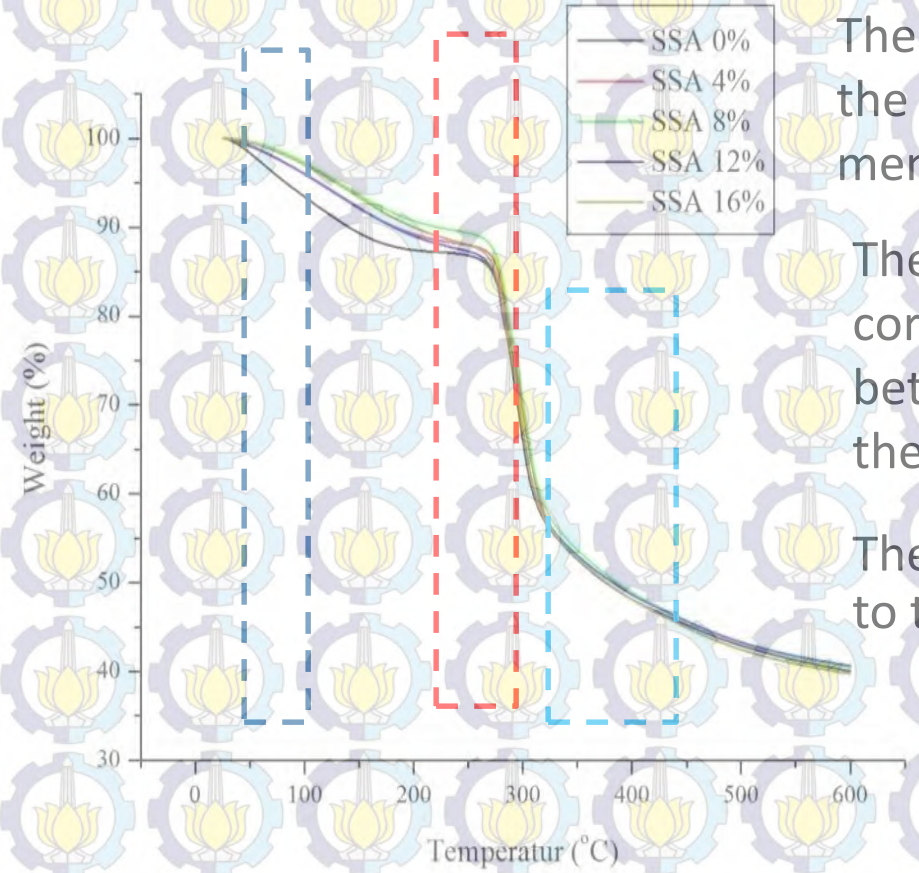
Membrane composite

CHARACTERIZATIONS

- TGA
- Methanol Permeability
- **Proton Conductivity**

RESULTS AND DISCUSSION

Thermal Property



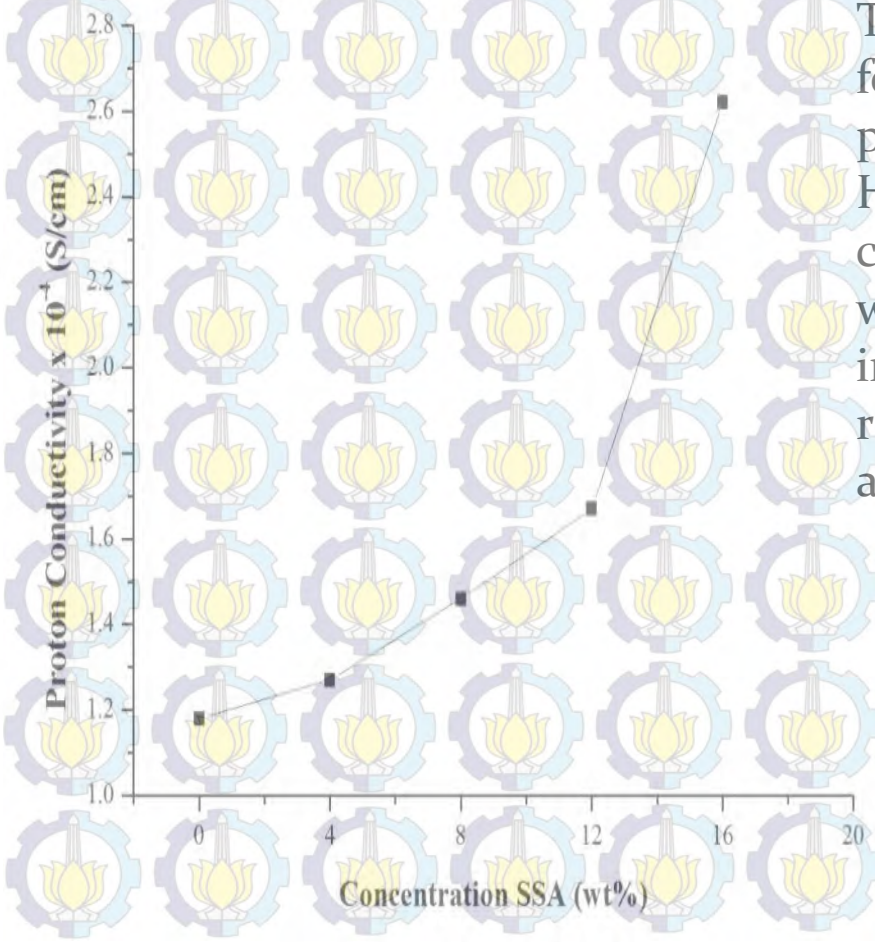
The first region (50-100˚C) was attributed to the loss of adsorbed water molecules in the membranes.

The second region (210-300˚C) was corresponded to the degradation of the bond between chitosan-silane and chitosan-SSA in the membranes.

The third region (310-450˚C) was attributed to the decomposition of chitosan chains.

RESULTS AND DISCUSSION

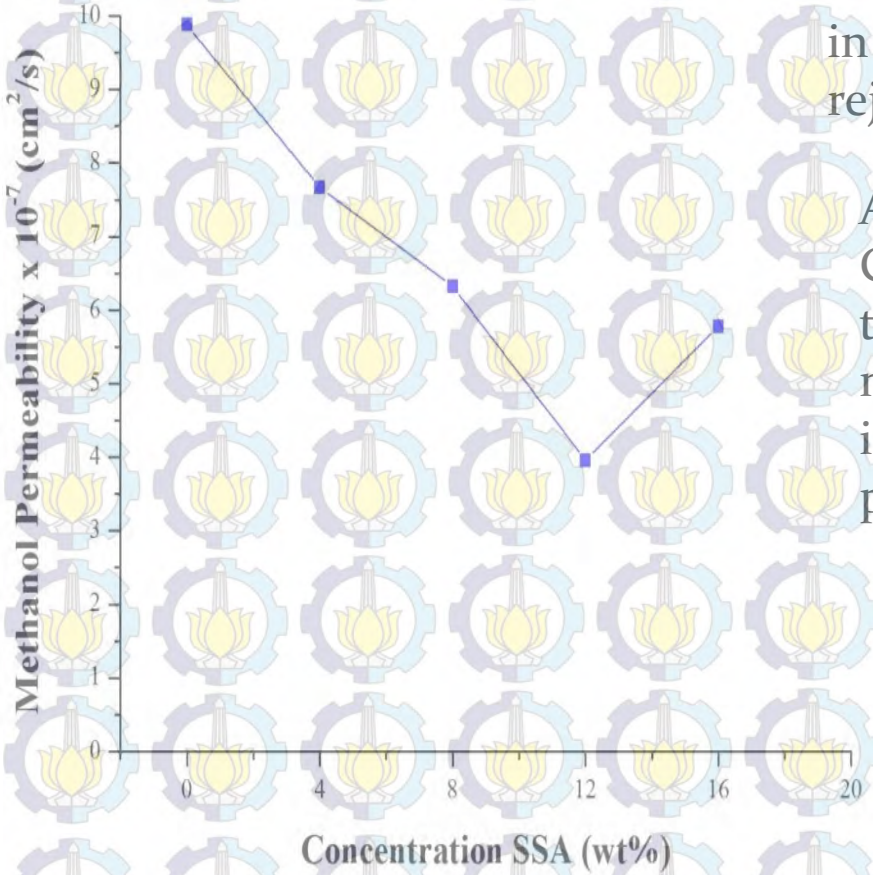
Proton Conductivity



The presence of $-SO_3$ groups leads to the formation of more accessible pathway for protons migration through the membrane. Hence, the observed high proton conductivity could be ascribed to the sulfonate groups as well as the hydroxyl and amine groups present in the ionomers, which give rise to hydrophilic regions in the structure due to their strong affinity toward water molecules.

RESULTS AND DISCUSSION

Methanol Permeability



The Use of sulfosuccinic acid was taken place in membrane to improve the methanol rejecting.

As seen, the methanol permeability of CS/MMT-Sil 10%/SSA 16% increased is due the increasing sulfonate groups, the methanol permeation rate increases, which is associated with the hydrophilic of these polar sites

CONCLUSSION

1. Using sulfosuccinic acid as crosslinking agent increase thermal stability, proton conductivity and decrease methanol permeability.

2. The composite membranes have been able to be synthesized with relatively low price, good thermal stability, low methanol permeability and high proton conductivity.

3. Best composition of composite membrane was found at CS/MMT-Silane 10%/SSA 12% with the highest proton conductivity of 1.67×10^{-4} S/cm and lowest methanol permeability of 3.96×10^{-7} cm^2/s


THANK YOU