ICOM 2011

Book of abstracts

Welcome

It is our great pleasure to welcome you at the International Congress on Membranes and Membrane Processes (ICOM 2011) organized by the Membrane Technology Group of the University of Twente, The Netherlands and held at the RAI convention center in Amsterdam from July 23-29, 2011.

We tried to compose an interesting and inspiring program covering the broad spectrum of topics in the field of membrane science and technology. We invited three plenary speakers from areas closely related to, though still at a certain distance from the field of membranes, to broaden the scope of the program and generate discussion and new insights. The program covers 78 keynote lectures at the start of each conference session, giving an overview of the past and future developments in that specific field. Next to that, it consists of almost 400 oral and more than 600 posters presentations, from students as well as from senior scientists in the field.

The social program includes a welcome reception and an exclusive boat tour from the convention center, through the canals of the old city of Amsterdam, to the former stock exchange building where the conference dinner will take place.

We would like to take the opportunity to express our sincere gratitude to the members of the organizing committee for all their efforts and altruistic support at the expense of their own work. Thank you very much. Without your help, ICOM 2011 would not have been possible!

We are very grateful to our sponsors and we highly value their financial support. Finally we would like to thank all members of the membrane community for their contributions and help to make this conference a success. We appreciate your input.

We wish you a wonderful ICOM 2011 and hope you will have a great time!

Kindest regards,

Kitty Nijmeijer
Antoine Kemperman
Matthias Wessling

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ICOM1086

Proton conducting membranes based on photopolymerizable monomers

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The proton exchange barrier or Proton Exchange Membrane (PEM) is the critical part of a fuel cell. The basic function of the membrane is to enable proton transport, while being simultaneously impermeable for electrons and gas. Typically, membranes for the PEM fuel cells (PEMFC) are made of perfluorocarbon-sulfonic acid monomers. The best known material of this class is Nafion which has a unique interpenetrating structure of hydrophobic perfluorocarbon regions providing thermal and chemical resistance, mechanical strength and diffusional resistance combined with hydrophilic regions of water clusters surrounding charged sulfonic acid groups which allow selective proton transport. For these reasons, Nafion is still considered the benchmark against
which most of the new materials are compared [1].

At the molecular level, proton transport may follow two principal mechanisms: (a) diffusion mechanism via H_3O^+ ion as a carrier and (b) proton hopping mechanism (Grotthuss transport) [2]. Contemporary PEMFCs are exclusively based on the vehicle mechanism.

PEMFCs produce water as a by-product and H^+ ions moving from the anode to the cathode pull water molecules by an electro-osmotic drag force. In addition, membrane suffers from evaporation of water at working temperatures of 60 - 90^oC. Nafion effectively conducts protons only when imbibed by water within a narrow range, which limits the operating temperature of PEM fuel cells to around 80^oC. However an operating temperature above 100º C is a highly desirable goal. PEM membranes are not dimensionally stable since the material significantly swells upon water absorption. Therefore the aim of our proton conducting membrane is a rigid polymer with perpendicular nano channels which are filled with a conducting sulfonic polymer where conductivity is mainly achieved by the Grotthuss mechanism.

Several monomers and crosslinker in a broad range of concentrations in water and 1-Methyl-2-pyrrolidone (NMP) respectively were screened for their mechanical properties, water uptake and conductivity in porous membranes by photo polymerization with a polar photo initiator. As conductive polymer, primarily poly(2-acrylamido-2-methylpropane sulfonic acid) (PAMPS) and poly(2-sulfoethyl methacrylate) (PSEM) respectively as well as polymers of phosphonic acid containing monomers or newly synthesized monomers were used. The conductive monomers were crosslinked with varying hydrophobic and hydrophilic multifunctional monomers like N,N'-methylene bisacrylamide (MBA), 2-Propenoic acid, 2-methyl-, 1,1'-(1,10-decanediyl) ester (D3MA) or polyethyleneglycol diacrylates with two varying chainlengths (PEG-DA700, PEG-DA330).

The advantage of several different building blocks with known characteristics is the possibility to tune the polymer to special needs of an application. For example, some polymer compositions have good conductivity at lower temperatures whereas other polymers develop better properties at elevated temperatures.

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1/Hamrock, S.J. and M.A. Yandrasits, *Proton Exchange Membranes for Fuel Cell Applications.* 2006. **46**(3): p. 219 - 244.

2/ Hoogers, G., *Membranes and Ionomers*, in *Fuel Cell Technology Handbook* G. Hoogers, Editor. 2002, CRC Press. p. 360