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**Appendix A**: Classification and characteristic features of fuel cells

| Type of Fuel Cell | Temperature (°C) | Efficiency (%) | Application | Advantages | Disadvantages |
|---|---|---|---|---|---|
| Alkaline fuel cell (AFC) | 50-90 | 50-70 | Space application | High efficiency | Intolerant to $CO_2$ in impure $H_2$ and air, corrosion, expensive |
| Phosphoric acid fuel cell (PAFC) | 175-220 | 40-45 | Stand-alone & combined heat and power | Tolerant to impure $H_2$, commercial | Low power density, corrosion, sulfur poisoning |
| Molten carbonate fuel cell (MCFC) | 600-650 | 50-60 | Central, Stand-alone & combined heat and power | High efficiency, near commercial | Electrolyte instability, corrosion, sulfur poisoning |
| Solid oxide fuel cell (SOFC) | 800-1000 | 50-60 | Central, Stand-alone & combined heat and power | High efficiency, direct fossil fuel | High temperature, thermal stress failure, coking, sulfur poisoning |
| Polymer electrolyte membrane fuel cell (PEMFC) | 60-100 | 50-60 | Vehicle and portable | High power density, low temperature | Intolerant to CO in impure $H_2$, expensive |
| Direct methanol fuel cell (DMFC) | 50–120 | 25-40 | Vehicle and portable | No reforming, high power density, low temperature | Low efficiency, methanol cross-over, poisonous by-product |

# CURRICULUM VITAE

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1999-2003 Bachelor Degree of Engineering (Petrochemical and Polymeric Materials), Faculty of Engineering and Industrial Technology, Silpakorn University, Nakornprathom, Thailand

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**Publications:**

1. Totsatitpaisan, P., Tashiro, K., Chirachanchai, S. (2008) Investigating Proton Transferring Route in Heteroaromatic Compound Part I: A Trial to Develop Di- and Trifunctional Benzimidazole Model Compounds Inducing The Molecular Packing Structure with Hydrogen Bond Network. Journal of Physical Chemistry A, 112(41), 10348–10358.
2. Totsatitpaisan, P., Nunes, S. P. and Chirachanchai, S. (2008) Investigation of The Effect of Benzimidazole-based Model Compounds on Thermal Properties and Proton Conductivities of Sulfonated Poly(ether ether ketone). Solid State Ionics, accepted.
3. Totsatitpaisan, P., Eiamlamai, P., Tashiro, K. and Chirachanchai, S. Benzimidazole Model Compounds and Their Consequent Molecular Packing Structures for Hydrogen Bond Network Channels. (To be submitted to Acta Materialia).
4. Totsatitpaisan, P., Takolpuckdee, P., Perrier, S. and Suwabun Chirachanchai and Chirachanchai, S. Controlled Chain Length of 4-Vinylimidazole Oligomer Prepared by Reversible Addition-Fragmentation Chain Transfer (RAFT) Polymerization. (To be submitted).

**Proceedings:**

1. Totsatitpaisan, P., Perriér, S., Chirachanchai, S. (2006, February) A New Heterocyclic Resonance Structured Polymer for PEMFC Part I: Synthesis and Characterization of Imidazole-based Polymer. The 7th Royal Golden Jubilee Ph.D Congress, Chonburi, Thailand.
2. Totsatitpaisan, P., Tashiro, K., Aukkaravittayapun, S., Vilaithong, T. and Chirachanchai, S. (2007, March 28-30) Development of Novel Material for Regular Proton Transferring Route Polymer Electrolyte Membrane: Synthesis and Characterization of Benzimidazole-based Model Compound. Proceedings of NAC2007 NSTDA Annual Conference Science and Technology for National Productivity and Happiness, Thailand Science Park, Pathumthani,Thailand.
3. Totsatitpaisan, P., Tashiro, K. and Chirachanchai, S. (2007, June 25-28) Molecular Design and Synthesis of Benzimidazole-based Model Compound for The Formation of Regular Proton Transferring Route in Anhydrous Polymer Electrolyte Membrane Fuel Cell. Proceeding of The 2nd International Conference on Advances in Petrochemicals and Polymers (ICAPP), Bangkok, Thailand.
4. Totsatitpaisan, P., Tashiro, K. and Chirachanchai, S. (2007, August 19-23) Molecular Design and Synthesis of Benzimidazole-based Model Compound for Development of Regular Proton Transferring System. Proceeding of 234th American Chemical Society National Meeting and Exposition, Boston, MA, USA.

**Presentations:**

1. Totsatitpaisan, P., Perriér, S., Chirachanchai, S. (2006, February) A New Heterocyclic Resonance Structured Polymer for PEMFC Part I: Synthesis and Characterization of Imidazole-based Polymer. Oral presented at The 7th Royal Golden Jubilee Ph.D Congress, Chonburi, Thailand.
2. Totsatitpaisan, P., Tashiro, K., Aukkaravittayapun, S., Vilaithong, T. and Chirachanchai, S. (2007, March 28-30) Development of Novel Material for Regular Proton Transferring Route Polymer Electrolyte Membrane: Synthesis and Characterization of Benzimidazole-based Model Compound. Oral presented at

NAC2007 NSTDA Annual Conference Science and Technology for National Productivity and Happiness, Thailand Science Park, Pathumthani,Thailand.

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**Honors and Awards:**

1. Scholar Student, Damrongchaitham Foundation, (1999-2003).
2. First Class Honor (GPA 3.62), Bachelor Degree of Engineering (Petrochemicals and Polymeric Materials), Faculty of Engineering and Industrial Technology, Silpakorn University (2003).
3. Full Scholarship, Master Degree in Polymer Science Program, The Petroleum and Petrochemical College, Chulalongkorn University (2003~2004).
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