Academic Journal of Polymer Science
ISSN: 2641-8282

Juniper Publishers
key to the Researchers

Opinion
Volume 5 Issue 2 - July 2021
DOI: 10.19080/AJOP.2021.05.555656

Academ J Polym Sci

Aliphatic-Backbone Polymers for Hydrocarbon-Based Membranes in Fuel Cells

Minkyu Kyeong*

Center for Hydrogen and Fuel Cell Research, Korea Institute of Science and Technology (KIST), Republic of Korea

Submission: June 25, 2021; **Published:** July 01, 2021

***Corresponding author:** Minkyu Kyeong, Center for Hydrogen and Fuel Cell Research, Korea Institute of Science and Technology (KIST), Republic of Korea

Abstract

Even though most of the studies have focused on perfluoroalkyl polymers and aromatic-backbone-containing hydrocarbon-based polymers, aliphatic-backbone-containing hydrocarbon-based polymers is strongly necessary due to not only the advantages of aromatic-backbone-containing hydrocarbon-based polymers such as comparable costs and structural diversity but also high ionic conductivity and efficient hydrophilic/hydrophobic phase separation. The aliphatic-backbone ionic polymers could be a promising candidate on further development of fuel cells.

Keywords: Aliphatic; Hydrocarbon; Membrane; Fuel cell

Introduction

Ion exchange membranes (IEMs) have been developed over several decades in which they applied to various applications such as desalination, water-splitting, flow battery, and fuel cells. With constant development of IEMs, IEMs received intent interests for commercialization due to their selective ion separation, fabrication of free-standing membranes, and durability in acidic/basic solution. In particular, after many researchers found ionic conduction in acid or base, IEMs have made rapid progress in fuel cells. Even though extensive studies have been conducted, a few ionic groups are survived such as sulfonic acids and phosphoric acids. However, it is more serious that types of structural units for backbones are also insufficient because specific chemical structures can be sturdy in acid or base. So far, several types of ionic polymer membranes are known to be used in fuel cells such as perfluoroalkyl polymers, poly(arylene ether sulfone)s, poly(arylene ether ketone)s, polyphenylenes, polybenzimidazoles, and polyethylenes. Among these polymers, the hydrocarbon-based polymers have a potential to move further improvement in fuel cells compared to the perfluoroalkyl polymers owing to affordable costs and structural diversity. In this regard, many studies of the hydrocarbon-based polymers have been carried out to change functional groups on backbones, or to synthesize crosslinked structures. However, crosslinked polymers are very difficult to fabricate membranes, and aromatic ring-only backbones in polymers have limitations in modulation of their physical properties. Therefore, development of new hydrocarbon-based polymers is still noteworthy.

To expand applicable chemical structures of monomers in hydrocarbon-based polymers, the previously reported chemical structures should be examined. The reason why most of the hydrocarbon-based polymers has aromatic rings on the backbones is to maintain rigidity of polymers for successful fabrication of membranes and to have commercial-availability for large scale synthesis. To make breakthroughs, introduction of aliphatic monomers on the hydrocarbon-based polymers could be one of the excellent solutions. Aliphatic monomers are able to make the backbones more flexible to have a rubbery state at low temperature, which leads to have good processability and a chance to form efficient hydrophilic/hydrophobic phase separation. Recent studies have demonstrated that aliphatic-backbone-containing hydrocarbon-based polymers have several advantages in fuel cells [1,2]. Particularly, aliphatic backbones help to enhance ionic conductivity and hydrophilic/hydrophobic phase separation. Moreover, these alkylated phenols are synthesized in a gram scale and are not required to change polymerization conditions. With the aid of chain flexibility, decal transfer methods which are adequate for mass production of membrane electrode assemblies [3]. For this reason, aliphatic-backbone-containing hydrocarbon-based polymers can be a good candidate in broadening fuel cell fields.

Conclusion

Development of new hydrocarbon-based polymers are required due to modulation of their physical properties so that

commercialization of the hydrocarbon-based polymers is realized. Because aromatic-backbone-containing polymers have limitations in poor processability due to rigid backbones, aliphatic-backbone-containing polymers are highlighted as a promising candidate due to their chain flexibility. This leads to high ionic conductivity and efficient hydrophilic/hydrophobic phase separation, resulting in expansion of fuel cell membranes.

References

1. Baolin Z, Gaohong H, Issam EH, Li G, Xiaoming Y (2017) A novel strategy for constructing a highly conductive and swelling-resistant semi-flexible aromatic polymer based anion exchange membranes. International journal of hydrogen energy 42(15): 10228-10237.
2. Xiaoming Y, Baolin Z, Jiafei L, Xinyue Z, Gaohong H (2018) Tailoring the nanophase-separated morphology of anion exchange membrane by embedding aliphatic chains of different lengths into aromatic main chains. Journal of Membrane Science 564(15): 436-443.
3. Jieun C, Minkyu K, Minsung K, So YL, Hyoung JK (2021) Synthesis of Sulfonated Poly(Arylene Ether Sulfone)s Containing Aliphatic Moieties for Effective Membrane Electrode Assembly Fabrication by Low-Temperature Decal Transfer Methods. Polymers 13(11): 1713.

DOI: 10.19080/AJOP.2021.05.555656

How to cite this article: Minkyu Kyeong. Aliphatic-Backbone Polymers for Hydrocarbon-Based Membranes in Fuel Cells. Academ J Polym Sci. 2021; 5(2): 555656. DOI:10.19080/AJOP.2021.05.555656