Partially Fluorinated Copolymer with Fully Sulfonated Grafts and its Blends with PVDF for Fuel Cell Membranes

Nielsen, Mads Møller; Yang, A.C.C.; Jankova Atanasova, Katja ; Hvilsted, Søren; Holdcroft, S.

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

Partially Fluorinated Copolymer with Fully Sulfonated Grafts and its Blends with PVDF for Fuel Cell Membranes

M. M. Nielsen[1, 2], *A. C. C. Yang*[2], *K. Jankova*[1], *S. Hvilsted*[1] *and S. Holdcroft*[2]
[1]*Department of Chemical and Biochemical Engineering, Danish Polymer Centre, Technical University of Denmark, DTU, DK-2800 Kgs. Lyngby, Denmark*
[2]*Department of Chemistry, Simon Fraser University, Burnaby, BC, V5A 1S6, Canada*
mon@kt.dtu.dk

Proton exchange membrane fuel cells (PEMFC) applied in vehicles are facing commercial launch in 2015 [1]. At this point the main disadvantage is high cost. A step in decreasing this is to find an alternative to current perfluorosulfonic acid ionomers benchmark membranes, e.g. Nafion®. Our approach builds on a partially fluorinated system that has been optimized by Holdcroft et al. [2-4]. Post-sulfonated (s) poly(vinylidene fluoride-*co*-chlorotrifluoroethylene) -*g*-polystyrene (P(VDF-*co*-CTFE)-*g*-sPS) at three different graft lengths was blended with PVDF to contain similar sPS volume fractions as a reference P(VDF-*co*-CTFE)-*g*-sPS with a different graft density and graft length. Three blends with half this sPS content were prepared as well. Films of both blends and the parental graft copolymers were solvent cast and all were characterized for fundamental PEM properties, in terms of water uptake and proton conductivity. At water uptakes of 25-40% (ion exchange capacity = 0.60-0.75 mmol/g) the proton conductivity was 48-51 mS/cm, i.e. in the range of Nafion®.

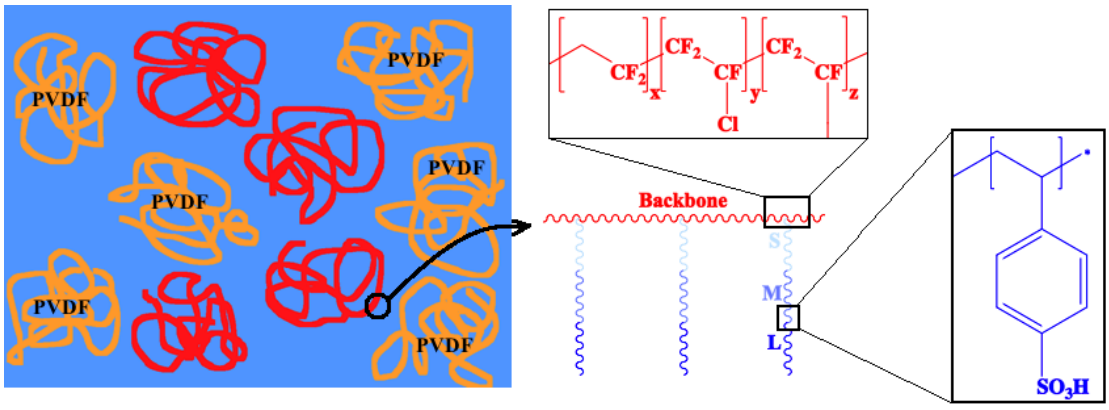

Figure 1. Illustration of the blend system and the parental graft copolymer system.

References

[1] Various authors, The Fuel Cell Today Industry Review 2011, www.fuelcelltoday.com, 06.02.12.
[2] Tsang, E. M. W.; Zhang, Z.; Shi, Z.; Soboleva, T.; Holdcroft, S. *J. Am. Chem. Soc.* **2007**, 129, 15106-15107.
[3] Tsang, E. M. W.; Zhang, Z.; Yang, A. C. C.; Shi, Z.; Peckham, T. J.; Narimani, R.; Frisken, B. J.; Holdcroft, S. *Macromolecules* **2009**, 42, 94667-9480.
[4] Yang, A. C. C.; Narimani, R.; Frisken, B. J.; Holdcroft, S. *unpublished.*