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Crosslinked Sulfonated Polyphenylsulfone (CSPPSU) Electrolyte Membranes for Energy Device Applications

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Abstract Text:
The abnormal phenomena caused by global climate change require the construction of a social system that can provide a stable supply of energy security while reducing CO_2 emissions to zero through carbon neutrality on a global scale. It is believed that the use of renewable energy sources such as solar, wind, and biomass will make it possible to realize a zero-CO_2 society. To utilize these energies efficiently, active research is being conducted into energy storage, conversion, and utilization technologies using batteries, solar cells, fuel cells, water electrolysis, and other such technologies. Meanwhile, polymer electrolyte membranes are among the key materials that realize the high performance of fuel cells, water electrolysis devices, and redox flow battery (RFB). For proton exchange electrolyte membranes, there is a demand for the development of low-cost, environmentally friendly non-fluorinated materials that have high proton conductivity and high durability under low and high humidity conditions as alternatives to poly- and perfluoroalkyl substances (PFAS).

We have developed a polymer electrolyte membrane using polyphenylsulfone (PPSU) as a hydrocarbon-based polymer as a non-fluorinated electrolyte membrane [1 – 7]. A hydrocarbon-based polymer electrolyte ionomer was synthesized by sulfonating PPSU polymer at different temperatures and times to obtain an ionomer with high ion exchange capacity (IEC=3.5 meq/g, DS=2). The SPPSU electrolyte membrane was prepared by dissolving the SPPSU ionomer in an organic solvent, casting it on a glass plate at 60 °C using a coater device, and obtaining a crosslinked SPPSU (CSPPSU) membrane by a thermal process up to 250 °C in an oven. The final membrane was obtained by an activation process in an alkaline and acid aqueous solution (wet process) to remove remaining impurities in the crosslinked membrane (Fig. 1). The physical and chemical properties of the obtained SPPSU ionomer and CSPPSU membrane were evaluated. In addition, an membrane electrode assembly (MEA) was produced using a CSPPSU membrane and a fuel cell evaluation was performed. These results allowed us to optimize the sulfonation and crosslinking conditions of the PPSU polymer. These results will be reported on the day.

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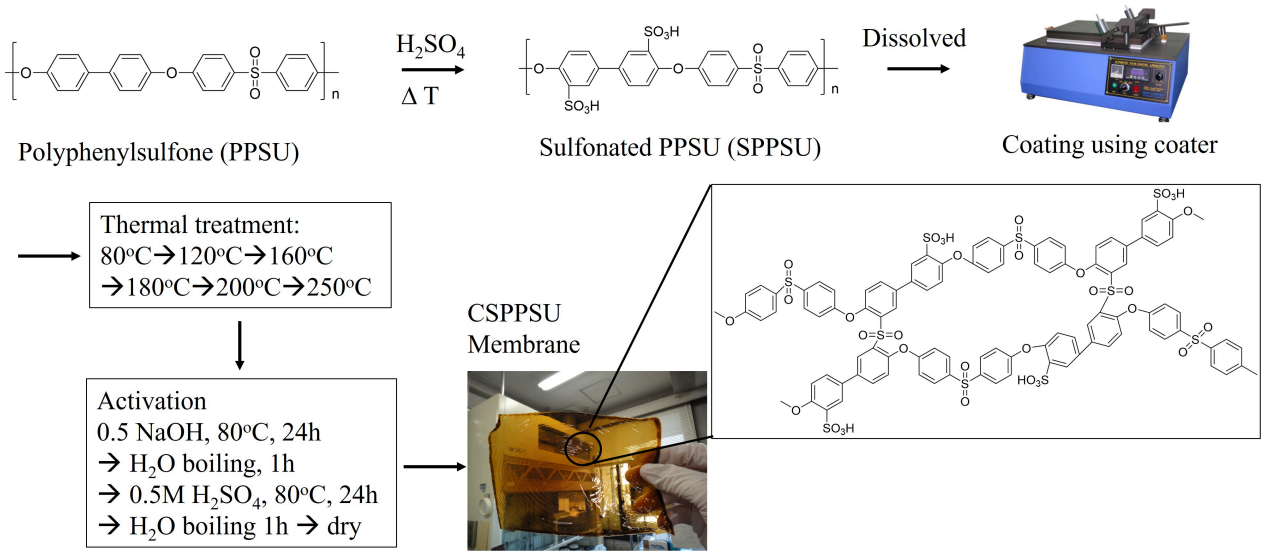

Fig. 1 Synthesis scheme of SPPSU and preparation process of crosslinked SPPSU (CSPPSU) membrane

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