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Chemical stability of new nafion membranes doped with bisphosphonic acids under Fenton oxidative conditions

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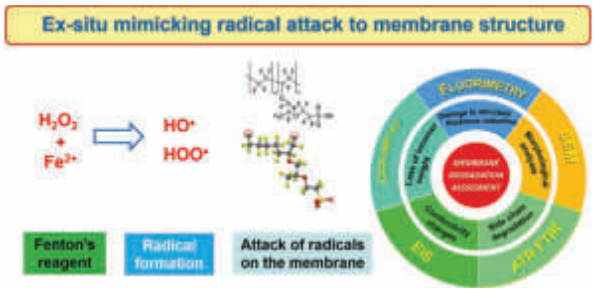
HIGHLIGHTS

- Chemical degradation was ensued by mimicking radical attack to membrane structure.
- Membrane degradation was assessed through ATR-FTIR, SEM, fluoride ion and gravimetry.
- New membranes show improved chemical stability vs Nafion after oxidative degradation.
- Results indicated higher degradation of the side chain of the ionomer.
- BP doped new membranes hold higher proton conductivity vs Nafion after Fenton's test.

GRAPHICAL ABSTRACT



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ABSTRACT

The development of new proton exchange membranes for PEM technology in fuel cells and electrolysers with increased durability is paramount to system's lifetime and scalability. In this work, new modified Nafion membranes doped with bisphosphonic acids are proposed with increased resilience to chemical degradation by H_2O_2/Fe^{2+}, mimicking *ex-situ* radical attack to membrane structure. Relevant properties were evaluated throughout Fenton's test using fluoride ion release and gravimetry determinations, and by ATR-FTIR spectroscopy and SEM before and after the chemical degradation. The new membranes showed a very good chemical stability after oxidative degradation under Fenton's test conditions at 80 °C, with more durability than Nafion 115 commercial membrane. After chemical degradation, the proton conduction of the membranes was assessed through EIS which reveals a decrease in the proton conductivity of all membranes, with the new modified membranes showing a smaller decrease of their proton conduction properties than Nafion

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