



## **CHAPTER V**

### **CONCLUSIONS**

The sulfonated PEEK and PPEES were prepared from 98% sulfuric acid at different reaction times to fabricate S-PEEK and S-PPEES membranes at various degrees of sulfonation (DS). S-PPEES can only be sulfonated at the DS value of about 80% due to the poor solubility of PPEES and the short reaction time. According to the results obtained from the characterizations and the testing, the properties of S-PEEK and S-PPEES membranes depend critically on DS. An increase in DS induces the increases in the water uptake, IEC, the proton conductivity, and the vanadium ions permeability. On the other hand, an increase in DS also induces a decrease in the mechanical property of the membranes because an increase in the water uptake can lead to low mechanical strength. S-PEEK and S-PPEES show lower vanadium ions permeability values than that of the Nafion 117 membrane. This work thus demonstrates the potential fabrication and utilization of low-cost proton exchange membranes with reduced vanadium crossover for the vanadium redox flow battery.