

High-performance proton exchange membranes for direct methanol fuel cells based on SPEEK/polybenzoxazine crosslinked structure

Chunxia Zhao, Da He, Yuntao Li, Jianfei Xiang, Peng Li and Hung-Jue Sue

Supporting Information (SI)

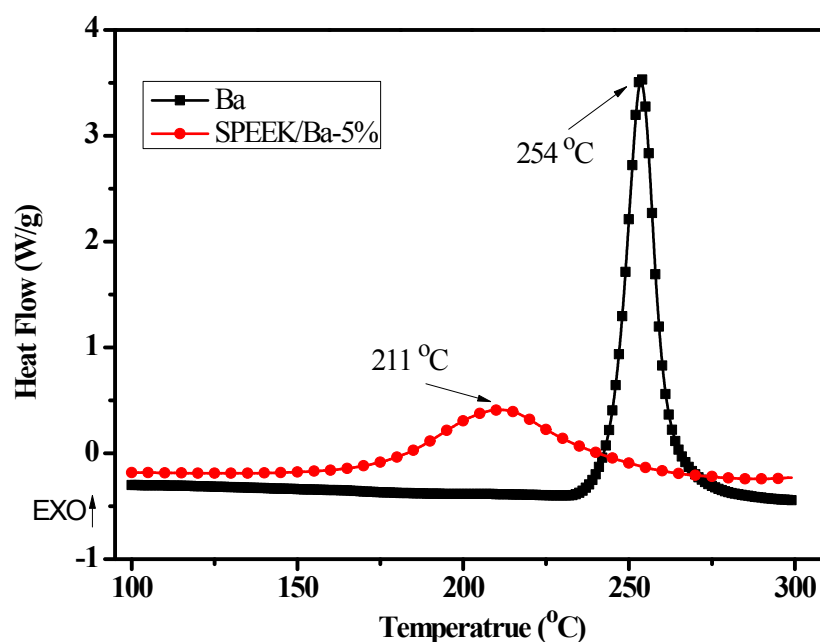


Figure 1SI DSC curves of pure Ba monomers and SPEEK/Ba-5% mix

DSC measurements were carried out on a TA Q200 differential scanning calorimeter under a constant flow of nitrogen at 50 mL/min at a heating rate of 10 °C/min. The instrument was calibrated with a high-purity indium standard. α - Al_2O_3 was used as the reference material.

The pristine Ba shows an exotherm with onset and max at 233 °C and 254 °C, respectively. The onset and max exotherms of SPEEK/Ba shift to much lower temperature ranges. The decrease of the exotherm temperature is believed to be the catalytic effect of the acidic groups in SPEEK on the ring opening polymerization of benzoxazine monomers.

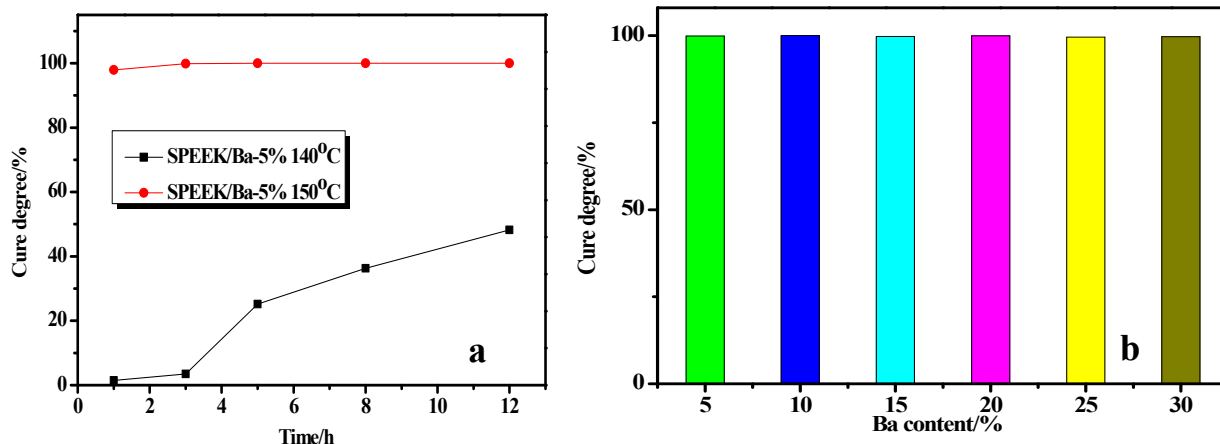


Figure 2SI (a) Curing degree of SPEEK/Ba-5% as a function of time, (b) Curing degree of SPEEK/Ba at 150 °C for 5h.

Benzoxazine monomer is dissolved in acetone. Solvent extraction is used to measure the cure degree of SPEEK/Ba at various process conditions. The cure degree (CD) is calculated by the following equation.

$$CD(\%) = \frac{M_0 - M_1}{M_0} \times 100\%$$

Where M_0 is the original weight of SPEEK/Ba membrane, M_1 is the uncured benzoxazine monomer extracted by acetone. It is obviously can be seen that the SPEEK/Ba membranes are all completely cured at 150 °C for 5h.