Toughening of Ultrahigh Thermoresistant Biopolybenzimidazoles by Forming Porous Structure

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Introduction

The production of various bioplastics from renewable biological resources is a prerequisite for developing a sustainable society. However, various bioplastics limits their engineering applications to their thermal resistance. Therefore, bio-derived aromatic molecules can be good candidates for use as renewable starting materials in the syntheses of thermoresistant engineering bioplastics. Recently, we succeeded to prepare bio-based polybenzimidazole obtained by the polycondensation of 3,4-diaminobenzic acid (DABA) and 4-aminobenzoic acid (ABA) (Fig.1). (1) It showed ultrahigh heat-resistance such as 10% mass-loss temperatures (T_{d10}) over 740 ℃. However, poly (DABA-*co*-ABA) membrane displayed rather brittle behavior due to their rigid structure. In this study, we report the enhancement of the toughness of poly (DABA-*co*-ABA) membranes by addition of SiO_2 spheres with monodistributed size and investigate the effects of porous ability.

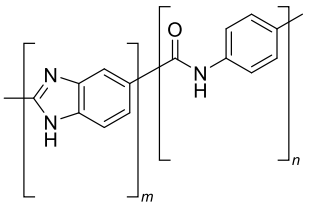

Fig. 1. The structure of poly (DABA-*co*-ABA).

Results and discussion

Porous poly (DABA-*co*-ABA) membrane was constructed via hard templating method using monodispersed SiO_2 solid spheres (300nm) and 40wt% hydrofluoric acid as template and etching solution. The pores with the diameter of about 300 nm was observed by SEM (Fig. 2c). As a result, the effect of porous structure on the membrane showed the improvement of elongation ability rather than poly (DABA) membranes. Thus, the PBI and poly (DABA-co-ABA) membrane by forming pore structures can be attempted for high thermoresistant insulators.

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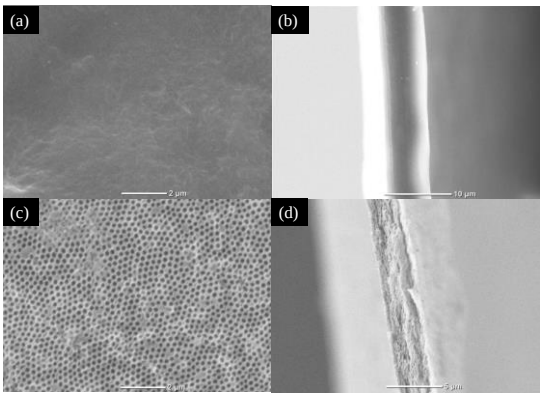

Fig. 2. SEM images of poly (DABA-*co*-ABA) membrane (a), and cross-section (b). Porous membrane (c), and cross-section (d).

References **(1)** T. Kaneko and coworkers, *Adv. Sustain. Syst*. **2020**, 2000193

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