

폴리이미드실록산/실리카 하이브리드막의 제조와 기체 투과 특성

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Preparation of Poly(imide siloxane)/Silica Hybrid Membranes and Their Gas Separation Properties

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Hybrid organic-inorganic materials have become an interesting field of research as the introduction of inorganic or organic molecules can improve the characteristics of a matrix. They are generally obtained via a sol-gel technique. The micro- and macrostructure of a hybrid composite can be controlled by the optimization of several synthetic parameters, for example, pH, concentration, water-to-alkoxide ratio, temperature, pressure, type of catalyst, and solvent at low temperature. Among these materials, polyimide-silica materials have become interestingly investigated [1-4]. In polyimide-silica hybrids prepared via a sol-gel process, silica particles are dispersed in a polyimide matrix [5, 6].

The control of morphology and phase separation is critical in the preparation and application of organic-inorganic hybrid composites. The introduction of well-dispersed and fine size (probably on a nanoscale) inorganic domain into a polymer matrix and the control of compatibility between and inorganic interphase will result in the maximized effectiveness in a given hybrid composite. The interest compatibility of PI-silica hybrid composite is, however, not good because of the restricted chain mobility and the lack of the appropriate backbone structure (e.g. carbonyl, hydroxyls or ether atoms) that can induce physical interactions with the growing inorganic oxide network.

In addition, most of the silica domains reported in the PI-silica hybrid composites were as large as 2-10 μm in diameter when the silica loading content is up to 20-30%. Several attempts have been conducted for high degree of homogeneity and reduction of inorganic domain size since the improvement of thermal and mechanical properties of hybrid composites can be obtained by controlling the morphology of hybrid composites. Although effective, there have been several disadvantages, such as modification of PI backbone, introduction of a poor solvent for polyamic acid, and uncommon inorganic precursors should be employed.

In this paper, we determine whether poly(dimethylsiloxane) (PDMS) can act as a compatibilizer of polyimide-silica hybrid composites. PDMS has been known to interact with silica because of the similarity of its backbone structure ($-\text{Si}-\text{O}-$) with the sol-gel glass matrix of silica precursor[7], indicating that copolymer with PDMS, poly(imide siloxane) segmented copolymer (PIS), might be a good candidate material for organic inorganic hybrid composites. Furthermore, the gas separation properties (He/N_2 , O_2/N_2 , and CO_2/N_2) of these hybrid membranes will be discussed in terms of their morphological aspects.

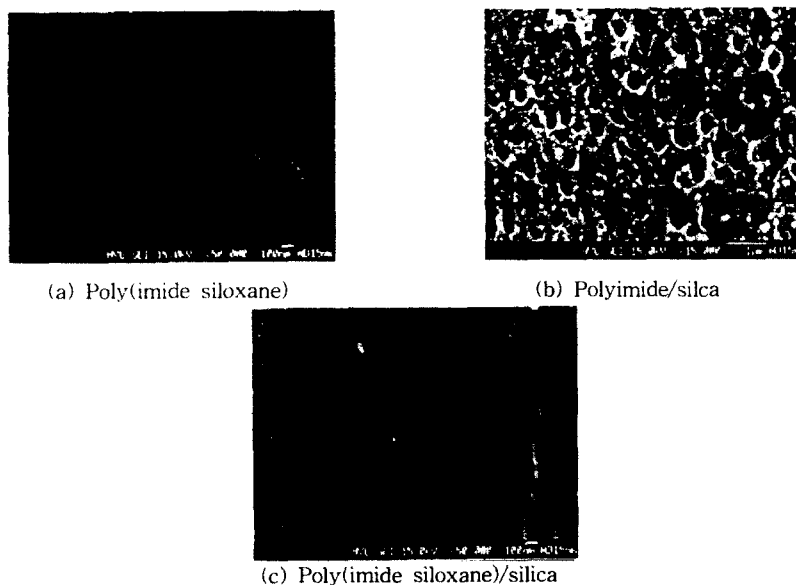


Fig. 1. SEM image of (a) PIS (b) PI/silica and (c) PIS/silica membrane

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