

Visualization of Acid-base Equilibrium Inside Perfluorosulfonic Acid Membranes Using Anthocyanin Derivatives

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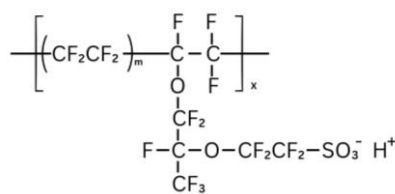
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Keywords: Anthocyanin Derivatives; Nafion Membrane; Acid-base Equilibrium

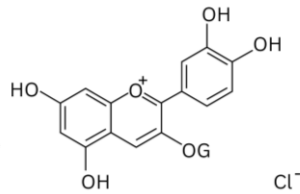
The acid-base equilibrium inside the perfluorosulfonic acid (Nafion[®]) membrane containing an anthocyanin derivative, i.e. chromanine chloride is studied. Previous studies have investigated Nafion membranes doped with functional dyes, including the response of methylene blue-containing membranes to changes in humidity¹ and the proton dissociation in bis(carboxylic acid) derivative-Nafion composite membranes exhibiting color changes around pH 12.²

The membranes were prepared by mixing a Nafion dispersion with a dye and casting on glass plates. A sufficient amount of aqueous sodium hydroxide and sulfuric acid solutions were dropped at 1 pH unit increments from pH 1 to 13 and at 0.1 pH unit increments from pH 12 to 13. The membrane discolored from red to blue at around pH 12.3, indicating that ion exchange occurs inside the membrane in the high pH range. After drying, the membranes turned pale brown, and visible spectra were measured in this state. The absorption spectrum of the dye-Nafion membrane showed a peak around 509 nm. No significant change in the absorption spectrum was observed before and after dropping solutions up to pH 12.2. However, for all membranes treated with solutions above pH 12.3, the absorption band disappeared. These results demonstrate that the acid-base equilibrium in the Nafion membrane changes significantly at high pH conditions.

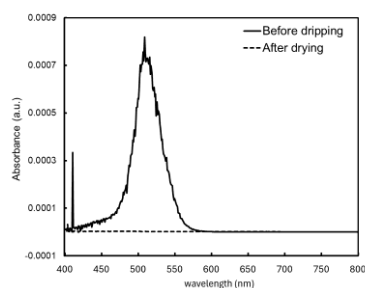
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Structure of Nafion



Chromanine Chloride



Visible spectra of membranes before and after adding pH12.8 NaOH

- 1) S. Otsuki, K. Adachi, *J. Appl. Polymer Sci.*, **1995**, 56, 697-705.
- 2) J-M. Zen et al. *Anal. Chem.*, **1991**, 63, 2934-2938.