CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

Porous clay heterostructures (PCHs) and hybrid organic-inorganic PCHs (HPCHs) derived from Na-bentonite clay have been synthesized by a surfactant directed assembly of silica species within the clay galleries. Before the modification, the pristine clay was adjusted pH to four conditions, including pH 9, 7, 5, and 3. HPCHs have been functionalized with the methyl group through co-condensation reaction to improve the hydrophobicity on the porous structures for finding a new application of these porous clays for ethylene scavenger films in active packaging. From the analysis of N_2 adsorption-desorption data, the results show that PCHs have surface areas of 501-668 m^2/g, an average pore diameter in the supermicropore to small mesopore range of 3.01-3.85 nm, and a pore volume of 0.43-0.64 cc/g, while HPCHs have a result of 469-582 m^2/g, 3.19-3.88 nm, and 0.33-0.49 cc/g, respectively. Moreover, the shape of the N_2 adsorption-desorption isotherms of these products are very similar which belong to a type IV BET isotherm, and also indicated that the framework pore sizes are in the supermicropore to small mesopore region. The ethylene adsorption capacity of these porous clays was investigated using gas chromatography. The results reveal that the enhancement of the hydrophobicity on HPCHs plays an important role in ethylene adsorption.

After the PCHs and HPCHs were obtained, the PCHs and HPCHs nanocomposites of PP have been prepared via direct melt intercalation by using a twin screw extruder. The dispersion of the 1 wt% porous clays in PP matrix is improved by incorporating 2 wt% of surlyn ionomer. When these materials were fabricated to thin films, the effects of these porous clay on the crystal structure, crystallization behavior, thermal properties and ethylene permeability were studied. According to XRD patterns, the five characteristic peaks of PP α-phase are observed in PP and the porous clay nanocomposites, indicating that the addition of the PCHs and HPCHs does not affect the crystal structure of PP matrix. Nevertheless, the crystallization behavior of PP is significantly affected by both the presence of a compatibilizer surlyn ionomer and porous clays as a consequence of their crystallization peaks shift to higher temperature than that of PP. Moreover, the porous clay nanocomposites have such a higher percentage of crystallinity than that of pure PP, suggesting that the PP-clay interface plays an important role in the crystallization behavior. The additions of a compatibilizer and various types of porous clay have minimal effect on the thermal stability because the PCHs and HPCHs could not act as a mass transport barrier. According to ethylene permeability test, both PCHs and HPCHs significantly affect on the ethylene barrier property of the nanocomposite films. This points out their potential use as active packaging film for ethylene scavenger prolonging shelf-life of fruit and vegetable.

Recommendations

To study the effect of pH on the formation of porous clay, pH adjustment should be performed simultaneously in the step of expanding clay layers by exchange with a cationic surfactant, to maintain the amount of H^+ in each pH condition presents in the interlayer of clay. The porous clay nanocomposites should be blended with varying the clay content and study the mechanical properties.