CHAPTER II

LITERATURE REVIEW

The formation of ultrathin films was developed about two decades ago. Many different systems of monomers, surfactants and substrates were studied because it can be applied to many applications. In 1987, Wu *et al.* tried to use admicellar polymerization to form ultrathin polymerized film on a solid surface. They used the most common and inexpensive materials in their experiments. Styrene, sodium dodecyl sulfate (SDS) and alumina were used as monomer, surfactant and solid substrate, respectively. Their experiments showed that admicellar polymerization can be divided into three steps including admicelle formation, monomer adsolubilization, and polymer formation. From adsorption isotherm of SDS, the presence of styrene was found to increase SDS adsorption. Ultrathin film of polystyrene of several nanometer thick was formed on alumina surface. Similar experiment was carried out using the polymerizable surfactant, sodium 10-undecenoate (Esumi *et al.*, 1991).

In composite materials, silica is an important component used as reinforcing filler for improving mechanical properties especially in rubber compound. The problem of silica reinforcing filler is non-bond interaction between silica and polymer functionalites. To solve this problem, modified surface silica was developed to improve compatibility between hydrocarbon elastomer and precipitated silica using admicellar polymerization. Many types of polymers and copolymers were chosen for coating. From mechanical property results, the modified silica can improve cure time and other mechanical properties of rubber compounds. The different types of coating materials, surfactant systems, and other conditions result in different properties of modified silica. Furthermore, the mechanical properties show that the copolymer offers superior characteristics to the homopolymer (Waddell *et al.*, 1995).

Conducting polymer film coating on substrate was also successfully carried out by admicellar polymerization. Funkhouser *et al.* (1995) synthesized polypyrrole formation on alumina surface using SDS surfactant. The objective was for electrical conducting application such as, electrode, sensor and others. They studied

adsorption isotherm of SDS surfactant and the effects of electrolyte and pyrrole concentration on adsorption isotherm. Pyrrole was found to cause a decrease in SDS adsorption while salt caused an increase in SDS adsorption.

Unhomogeneous glass fiber surface was formed when coating with polystyrene via admicellar polymerization technique (Sakhalkar *et al.*, 1995). The data show that styrene in supernatant reduced with time after equilibrium of bilayer surfactant was formed on the substrate because styrene moved to the interior of micelle to polymerize. In addition, polymerization also occurred in aqueous phase but it was much lower than that in micelle. The reasons of nonuniformity of glass fiber surface were unhomogeneous of fiber surface.

Jianxi Zhao *et al.* (1995,1996) determined the equilibrium concentration of surfactant using surface tension measurement for studying the adsorption of alkyltrimethylammonium bromide on polystyrene latex particles. The calibration curve used is the semilogarithmic plot of surface tension versus surfactant concentration.

O'Haver *et al.* (1996) modified precipitated silica surface using polar comonomer and a cationic surfactant, cetyltrimetylammonium bromide (CTAB). By studying the mechanical properties, they found that they could produce new classes of reinforcing fillers where improved the physical properties of rubber compound. In 1996, adsolubilization mechanism of styrene and isoprene in CTAB admicelle on precipitated silica was investigated by Kitiyanan *et al.* (1996). The adsolubilization equilibrium constants were used as a key parameter. The adsolubilization equilibrium constant indicated that styrene adsolubilized into both palisade layer and the core of the micelle, and isoprene adolubilized into the palisade layer. In comonomer systems, slope of adsolubilization isotherm dramatically increased. It can be concluded that comonomer adsolubilization is better than monomer system.

In 2002, admicellar polymerization process was used to improve the processibility and utility of polypyrrole by Bunsomsit *et al.* They coated polypyrrole on natural rubber latex substrate using anionic surfactant (SDS) and ammonium persulfate initiator. Moreover, the effects of salt (NaCl) and pyrrole concentration on SDS adsorption isotherm were studied. From this study, the conductivity of the films improved significantly with salt addition. Pyrrole caused a decrease in SDS

adsorption at equilibrium. Sodium chloride caused an increase in SDS adsorption and pyrrole adsolubilization. Thermogravimetric results were used to characterized that natural rubber coated by polypyrrole.

Pongprayoon *et al.*(2002) coated thin polystyrene film on cotton by admicellar polymerization using linear alkylbenzene (LAS) surfactant. He investigated the rate of LAS adsorption on cotton, and effects of pH and electrolyte on adsorption of LAS on cotton. At high pH, LAS adsorption will be low. At high concentration of salt, LAS adsorption will be high. The property of cotton after coated with styrene shows increase in water resistance. The polystyrene film was characterized by SEM, FTIR and GPC. The polystyrene film coated on non-porous silica produced by admicellar polymerization was synthesized and characterized by Arayawongkul (2002). The system consisted of styrene monomer, CTAB, non-porous silica and AIBN initiator. Characterizations were done by FTIR, GPC, thermogravimetric analysis and atomic absorption.