

CHAPTER I

INTRODUCTION

The surface modification of substrates by admicellar polymerization has been investigated for two decades. Admicellar polymerization, a term derived from “adsorbed” and “micelle”, defines a class of *in situ* polymerizations taking place inside of adsorbed surfactant aggregates on various substrates, almost always inorganic particles with hydrophilic surfaces. This novel process has been studied on a variety of inorganic substrates, e.g. silica, alumina, titanium dioxide, using various types of surfactants, initiators and monomers. Detailed studies of the process are available for the formation of polystyrene on alumina (Wu *et al.*, 1987), polytetrafluoroethylene on alumina (Lai *et al.*, 1995), polystyrene on precipitated silica (O’Haver, 1994), styrene-butadiene copolymer on precipitated silica (Thammathadanukul *et al.*, 1996), styrene-isoprene copolymer on precipitated silica (Kitiyanan *et al.*, 1996 and Nonthasorn, 2002), and styrene on nonporous silica (Arayawongkul, 2002; Aumsuwan, 2003).

In previous studies, admicellar polymerization has been used to improve the adhesion between a filler substrate (usually amorphous precipitated silica) and polymer matrix (natural, butyl, and SBR compounds) by modifying the substrate with an ultrathin polymer film. Homopolymer and copolymer were used to form ultra thin films on the silica surface, and the results were reported on rubber testing properties such as tear strength, abrasion resistance, and tensile properties (Waddell *et al.*, 1995; O’Haver *et al.*, 1996; and Thammathadanukul *et al.*, 1996). Styrene-butadiene and styrene-isoprene copolymers are the first copolymers used to modify the silica surface. When compared to unmodified silica, both modified silicas show improved rubber physical properties when used as reinforcing fillers in rubber compounds. These results show the potential for economically modifying silica by admicellar polymerization. For these reasons, it is both scientifically interesting and industrially important to more fully understand and quantify the amount of each monomer that is available for polymerization on the silica surface. The styrene/isoprene-modified silica has greater improvement in the compounds physical properties because isoprene is a liquid at room temperature and pressure, unlike

butadiene. It will be advantageous to use liquid monomers, e.g. styrene and isoprene in admicellar polymerization technique (Thammathadanukul *et al.*, 1996). Since the structures between the styrene/isoprene modification and the natural rubber (*cis*-1, 4-polyisoprene) are relatively similar, this may result in increased compatibility between silica and rubber.

In this work, the admicellar polymerization technique is used to form styrene-isoprene copolymer on to the surface of nonporous silica (Aerosil[®] OX50). The proposed research is aimed at characterization of the copolymer thin film formed on silica surface under various monomers and surfactant concentrations. Modified silica, extracted silica, and extracted polymer will be examined by Fourier transform infrared (FTIR), thermogravimetric analysis (TGA), gel permeation chromatography (GPC), and atomic force microscopy (AFM).