CHAPTER 6

CONCLUSIONS

The improvement in hydrophobicity of PET, mixed Thai silk, Thai silk and cotton was observed with utilization of SF_6 plasma treatment using RF-ICP system. In this thesis, we investigated the optimum operating condition for improvement hydrophobicity of fabrics and characterized treated fabrics.

The optimum operating condition for improvement hydrophobicity was investigated by varying SF_6 pressure, RF power and treatment time. To evaluated the hydrophobicity, we performed measurement of contact angle and absorption time. All fabrics treated by SF_6 plasma have significantly higher contact angles than untreated fabric approximately three times. As a consequence the surface energy decrease approximately seven times. Moreover, the absorbtion time of the treated fabric increases from 0-30 min to the maximum experiment time limit of 210 min, depending on the type of fabrics. We found that for short treatment time (1min), the absorption time depended strongly on SF_6 pressure and RF power because at short treatment time, higher SF_6 pressure and RF power are essential for increasing amount of fluorine species in the plasma. On the other hand, the absorption time prominently increases as the SF_6 pressure and RF power are increased. However, at RF power of 75 watts (the maximum experiment RF power) the absorption time decrease compared with that at RF power of 50 watts. This is due to plasma is unstable and does not cover all over sample fabrics. So, in our RF-ICP system the optimum operating plasma condition for improvement hydrophobicity properties of fabrics is obtained at RF power of 50 watts and pressure of 0.5 Torr.

For surface morphology, treated fabrics with SF_6 plasma are rougher than untreated fabrics. The increased roughness of treated fabrics is in the order of nanometer range for all samples, which is in same order of magnitude as value reported by Poleti et al. [38], and Gupta et al. [39]. The increased nanoroughness is very small compared to the size of water droplet used in the experiment. Moreover, previous work reported that plasma treatment to improve hydrophilicity properties of fabric with another gases such as Ar, N_2, O_2, He, H_2 and CH_4 can also increase nanoroughness of fabric surface [6, 25, 39, 45]. So, the increase of roughness on treated fabric surface is not the main reason to improve hydrophobicity.

The result from XPS analysis showed participation of fluorine-containing groups (CF, CF_2, CF_3) in fabric surface after SF_6 plasma treatment. The amount of fluorine on sample surface increases as the RF power, SF_6 pressure and treatment time are increased. We found that the amount of fluorine is directly related to the absorption time. The information from the XPS experiment indicates that the fluorine atoms in SF_6 plasma are only active species interacted with the fiber. On the other hand, the fluorine atoms are source of hydrogen abstracting and attached with carbon composite in the fiber lead to C-F bound. Incorporation of fluorine atoms, which have a small atomic radius and high electronegativity, can provide a low surface energy [12, 36, 47]. This is the main reason for improvement hydrophobicity properties of the fabrics.