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（博士課程）
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論 文 要 旨

THESIS SUMMARY

専攻： Department of	有機高分子・物質　専攻	申請学位（専攻分野）： Academic Degree Requested	博士　（工学） Doctor of
学籍番号： Student ID Number		指導教員（主）： Academic Advisor(main)	鞠谷　雄士
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要旨（英文 800 語程度）
Thesis Summary (approx.800 English Words)

In this thesis, mechanism of surface roughness development in the newly developed technology for the production of fibers for artificial hair was investigated. In the production of fibers for artificial hair, control of surface roughness is indispensable for achieving good appearances.

Chapter 1 is the general introduction of this thesis. It was stated that incorporation of surface roughness is necessary in the production of fibers for artificial hair since human hair as well as hair of any animal exhibits surface roughness. Various technologies developed in the artificial hair industry for producing synthetic fibers with surface roughness was introduced. However they all have disadvantages. Meanwhile, we found that the fibers with a highly developed rough surface can be formed in melt spinning. The objectives of this thesis were also be expounded.

In chapter 2, to elucidate the necessary conditions for the development of roughness on the surface of blend fibers, melt spinning of various combinations of blend polymers were carried out under a wide-range of spinning conditions. It was concluded that the necessary conditions for the formation of surface roughness are: (1) the minor component is a crystalline polymer, (2) the major component is melt processable at a temperature lower than the melting temperature of the minor component and (3) extrusion temperature is lower than the melting temperature of the minor component.

In Chapter 3, three kinds of optical equipment were applied for the quantitative evaluation of surface roughness of PA6/PET blend fibers with and without roughness. In this research, optical microscope, scanning electron microscope and edge-detection type diameter monitor (EDDM) were applied for off-line evaluation of the surface roughness, while back-illumination type diameter monitor (BIDM) which has low positional resolution was applied for on-line measurement of surface roughness development in the melt spinning process. Optimum method of data analysis for evaluation of parameter Ra which stands for the degree of roughness was investigated. There was a fairly high correlation between the Ra

values obtained from the off-line measurement of as-spun fibers using the EDDM and those from the on-line measurement of the spin-line using the BIDM. Utilizing such correlation, according to the diameter data took by BIDM along the spin-line, it was revealed that the roughness develops gradually with the increase of distance from the spinneret in the spinning process.

In chapter 4, effects of several processing parameters in melt spinning process on the development of surface roughness were investigated. Surface roughness can be enhanced when extrusion temperature was lowered. Smaller nozzle diameter could lead to the increase of the true temperature of polymer blends in the spinning nozzle. Accordingly, the fibers produced using a nozzle of larger diameter showed higher degree of surface roughness at the same extrusion temperature. On the other hand, because of the combination of spinnability and extrusion temperature, the most developed roughness appeared for the fiber produced with the nozzle diameter of 1.0 mm. The larger through-put rate and lower take-up velocity also lead to the increase in the Ra values of PA6/PET blend fibers, while the Ra/D values, the degree of roughness standardized by the fiber diameter, increased at the lower through put rate and higher take-up velocity where thinner fibers were produced. Lastly, incorporation of the water bath in the spin-line and the use of PET with higher intrinsic viscosity were found to cause the decrease of surface roughness.

In chapter 5, for the PA6/PET blend fibers prepared with various spinning conditions, cold crystallization behavior of PET component was analyzed from the DSC thermogram, while crystalline state of PET component was also analyzed from the WAXD intensity analysis. The fibers with rough surface tend to exhibit crystalline reflection of PET in the WAXD diagram, while cold crystallization peak of PET was less distinct in the DSC thermogram. On the other hand, the fibers with smooth surface tend to exhibit distinct cold crystallization peak while crystalline reflection was less distinct. The negative correlation between the Ra values and cold crystallization peak area as well as the positive correlation between the Ra values and crystalline peak intensity were confirmed. On the other hand, it was also revealed that the PET component in the fibers with rough surface keeps its high crystallizability even after its melting. Through the analysis for the differentiation of PET components in PA6/PET blend fibers, it was found that PET particles exist under the protruded part of rough fiber surface, while the surface is covered with PA6 component. These results strongly suggested that the crystallization of PET component in the spinning process is indispensable for the development of surface roughness, while the crystallizability of PET component was enhanced by the polymer flow especially near the spinneret.

Chapter 6 is the general conclusions. The achievements of this thesis are summarized.