氏名	YIN CHUAN
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学位論文題目	Study on electrospun silicone modified polyurethane nanofibers (エレクトロスピニング法により作製したシリコーン変性ポリウレタンナノファイバーに関する研究)
論文審査委員	主査　教　授　　髙寺　政行 准教授　　田中　稔久 教　授　　玉田　靖 教　授　　倪　慶清 教　授　　岩田　忠久（東京大学） Associate Professor　Xiangqiang Pan （Soochow University）

論　文　内　容　の　要　旨

My research is focused on two main objectives, the preparation and characterization of silicone modified polyurethane nanofibers, and then analyze the physical properties to apply them to in vitro applications.

Silicone modified polyurethane (PUSX) has attracted as useful material by various properties which combined with silicone and polyurethane, such as heat resistance, weather resistance, peeling of molding, oil resistance and high mechanical strength. Currently, we use PUSX as films, molding products or adhesive, but there is no report of PUSX as fiber, in specific as nanofiber. Electrospun nanofibers including polyurethane nanofibers have attracted much attention due to their unique properties such as very large surface area to volume ratio, flexibility in surface functionalities, superior mechanical performance, high porosity, and good interfacial adhesion. It has been also considered as a new material with great potential in cell adhesion and proliferation because of the similar porous structure with extracellular matrix.

The electrospinning process of PUSX on the lab scale device was optimized and PUSX nanofibers with mean diameter ranging from 402 to 720nm were successfully prepared. Then a multinozzle pilot scale set-up was used to investigate the potential and limitations of preparing PUSX nanofibrous sheets using different equipment. The morphology and diameter of the obtained fibers were studied via scanning electron microscopy (SEM). Attenuated total reflectance-Fourier transform infrared spectroscopy (ATR-FTIR) was also carried out to analyze the chemical structure of PUSX nanofibers. As a result, we successfully found out the optimal parameters of PUSX electrospinning process and investigated the effects of solvents and solution concentrations on the electrospinnability of PUSX solutions along with the morphological appearance of the as-spun nanofibers and chemical structures were all characterized. We demonstrated the great potential of the process for mass production of PUSX nanofibrous sheets from solutions by a study of the reproducibility and feasibility of the electrospinning parameters performed on a pilot scale electrospinning set-up.

All prepared nanofibers are analyzed in detail by various methods and compared with films. Tensile tests were performed to investigate the mechanical properties such as tensile strength, elongation at break and Young’s modulus. The water contact angle

(WCA) measurement and water retention tests were carried out to determine the hydrophobicity of PUSX material. Thermal conductivity was analyzed in order to discuss the heat retention ability of PUSX nanofibers and films. As a conclusion of all the physical properties analysis, mechanical properties and water retention can be controlled and improved by adjusting the PUSX chemical structure. Higher hydrophobicity and lower thermal conductivity were also found in PUSX nanofibers by water contact angle, water retention and thermal conductivity measurement. We can expect this material to be applied in various fields. For instance, by controlling the silicone chain length and concentration of block type PUSX nanofibers, we may apply it in medical field such as bandage or scaffold, apparel field such as outdoor goods and sportswear, also we can use it as air or water filters.

In order to reveal the potential in cell adhesion and proliferation, NIH3T3 mouse embryonic fibroblasts cells were cultures on all the samples following by LDH activity. The toxicity of PUSX nanofibers and films was evaluated by using direct contact based on ISO 10993-5. The results shows that the PUSX nanofibers are able to be applied in cell culture (scaffold) field and shows very less toxicity of the material. Compared with films, PUSX nanofibers shows better cell attachment in short period. Electrospun PUSX nanofibers have been successfully proved to be an ideal material in biomedical applications such as wound dressing and tissue engineering thanks to the excellent physical properties and biocompatibility.