# 전기방사를 통한 Hydroxyapatite/Silk Fibroin 복합체의 제조

황수연, 권순철, 김종훈, 홍호범, 정성훈
한양대학교 섬유고분자 공학과

# Preparation of Hydorxyapatite/Silk Fibroin Composites via Electorspinning

**Suyeon Hwang, Soonchul Kwon, Jonghoon Kim, Hufan Hong, Sunghoon Jeong***
*Department of Fiber and Polymer Engineering, College of Engineering, Hanyang University, Seoul, 133-791, Korea*

## 1. Introduction

The organic-inorganic hybrids have both the advantages of organic materials, such as light weight, flexibility and good moldability, and inorganic materials, such as high strength, heat stability and chemical resistance [1]. Electrospinning is a simple and versatile method for generating ultrathin fibers from a rich variety of materials that include polymers, composites and ceramics [2]. Silk fibroin(SF) is one of the most desirable biomaterials because of its biocopatibility and higher mechanical properties comparing to other protein fiber. Hydroxyapatite(HAp) is also a very promising candidate because of its excellent biocompatibility and nontoxic hypostasis with organic tissues and its adsorbability of bacteria and replication competent human virus [3]. However, HAp is so brittle that it is difficult to prepare any form except particle. In the past studies, HAp/polymer composites were prepared by dispersing HAp in polymer solution or using SBF(Simulated Body Fluid). In this study, SF/HAp composites were fabricated by padding HAp on electrospun SF web and characterized.

## 2. Experimental

### 2.1. Materials

Silk was purchased from KATRI(Korean Apparel Testing & Research Institute). Formic acid(>98%), $Na_2CO_3$, $CaCl_2$, $Ca(OH)_2$, $H_3PO_4$ and methanol were purchased from Sigma Aldrich. Regenerated cellulose tubular membrane (Nominal MWCO : 12000-14000) was purchased from Membrane Filtration Products. Inc.

### 2.2. Methods

Silk fabrics were boiled for 30min in an aqueous solution containing 0.5% $Na_2CO_3$ and extract the sericin proteins through rinsing with distilled water. The extracted silk was then dissolved in $CaCl_2$/EtOH/$dH_2O$ (1:2:8 molar ratio) at 95℃ for 5 hours. This solution was dialyzed in water using regenerated cellulose tubular membrane, filtered with filter paper and then, lyophilized to obtain sponge like silk fibroin. Silk fibroin solution of 10-30% was prepared by directly adding the sponge like silk fibroin to formic acid. Elctrospinning dope was obtained by stirring for at least 24 hours at room temperature. The capillary was connected to a syringe filled with spinning dope. A

constant volume flow rate of 0.3ml/hour was kept using a syringe pump. The voltage was maintained at 15kV and the distance between the capillary tube and the collection screen was 12cm. The electrospun fibers were collected on a collection plate until electrospun web was obtained sufficiently and it was detached from the collector. HAp was prepared through the microwave processing [4]. HAp particle size dispersed in distilled water was measured by Microtrac(Nanotrac$^{TM}$ 150). Electospun web was dipped into methanol for 30min. Electrospun web treated by methanol was dipped into HAp dispersed distilled water at 0.1%-1% concentration for 10-60 min [5]. The HAp/SF composites were characterized.

## 4. Results and discussions

The electrospun web prepared well when 20wt% SF/formic acid solution was used. As the concentration of SF/formic acid solution was increased, the structural features were changed from bead(below 15wt%) to beaded fibers(15-19wt%), and finally to bead-free fibers(20wt%). As seen in Fig 1, the size range of HAp particles was 100-1500nm. The average diameter of SF fibers were 100nm. By means of this simple method, we prepared the electrospun HAp/SF composites. In addition, it was confirmed the HAp particles were well dispersed in the interconnected structure of electorspun SF web.

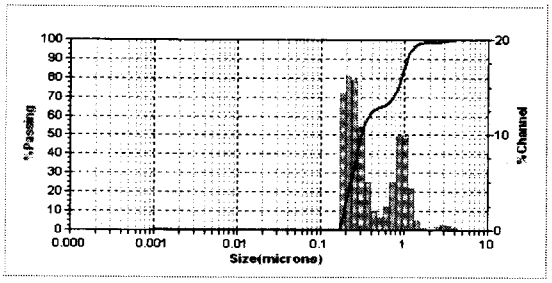


Fig 1. HAp particles size distribution

## 4. Conclusions

We fabricated the electrospun HAp/SF composites, by this facile method. The prepared nanocomposites have great potential to be applied for the filtration media.

## Reference

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