EGG ALBUMEN – A PROMISING MATERIAL FOR FABRICATION OF NANOPOROUS MATS

by

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The natural protein, egg albumen, is used for fabrication of nanoporous mats by bubbfil electrospinning. In our experiment, starch is used as an additive. By suitable choices of the spinning conditions, a mat with nanopores can be produced, and the spinning process is tenable by controlling the thermodynamic properties of spun solution and spinning environment.

Key words: *electrospinning, egg albumen, nanoporous material*

Introduction

Egg albumen is an excellent natural source of protein. Compared with other proteins, egg albumen is a low cost material, and it exhibits several interesting functionalities that make it interesting for various industries [1]. It has the ability to stabilize emulsions and a high potential to be used as carriers for controlled release of active compounds (due to its pH- and temperature-sensitive properties) [1]. Egg albumen-based ultrafine fibers have many medical and biological applications because such fibers can withstand the stomach's severe acidic condition and release the bioactive material at the alkaline pH of the intestine [2]. Egg albumen can also be used for fabrication of edible nanofibrous thin films [1]. In this research, the natural protein is chosen as the material for fabrication of nanoporous mats by bubbfil spinning process [3-5].

Experiments

An egg was bought from a market, and the egg albumen was obtained by breaking the egg without any treatment. Edible starch was used as additive to prepare for a spun solution, and its weight concentration was 5%. The albumen was then used for spinning by bubbfil electrospinning without any solvents. The morphology of the electrospun mats was observed by field emission

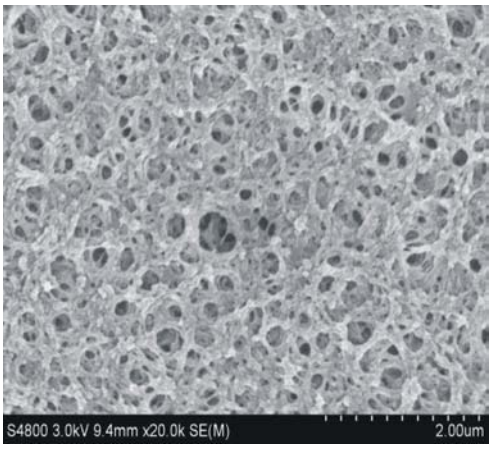

Figure 1. Nanoporous mat

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scanning electronic microscopy (SEM), S-4800, Hitachi Ltd., Japan. Figure 1 is the SEM illustration showing overall uniform nanoscales pores on the mat, the average pore size is about 20 nanometers.

Discussion and conclusion

The viscosity of egg albumen is too small to be used for spinning, the albumen needs to be mixed with edible starch to enlarge its viscosity. After mixing, superfine fibers can be obtained, and the diameter of the fiber strongly depends upon the solution's viscosity:

$$d \propto \eta^{\alpha} \tag{1}$$

where d is the fiber diameter, η – the viscosity, and α – the scaling index, which changes according to the solutions.

Equation (1) reveals the additive will greatly affect the spinning process. We choose wt. 5% starch additive to obtain porous mats instead of smooth fibers.

Our experiment also showed that the environmental temperature will also greatly affect the spinning process. The temperature will affect the solution's viscosity greatly, and in our experiment nanoporous mat can be obtained when the environmental temperature is below 15 °C.

To be concluded that egg albumen can be used for fabrication of superfine fibers, nanoparticles, and other morphologies at different spinning conditions. Nanoporous mat can be produced when the edible starch is added with weight concentration of 5% and environmental temperature is below 15 °C. The obtained nanoporous mat has been potential applications in biological and medical applications.

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