# Application of Alternating Current electrospinning for the fabrication of nanofibrous layers functionalized with active substance

[1]Levitskaya Venera[1], e-mail: venera.levitskaya@tul.cz, [2]Bendová Kristýna[1], e-mail: kristyna.bendova@tul.cz
[3]Novák Ondřej[1], e-mail: ondrej.novak3@tul.cz, [4]Tomillo Amorós Marta[1], e-mail: marta.tomillo.a@gmail.com,
[5]Horáková Jana[1], e-mail: jana.horakova@tul.cz, [6]Chvojka Jiří[1], e-mail: jiri.chvojka@tul.cz

**Abstract:** The incorporation of active substances, such as drugs or others, adds functionality to the nanofibrous layers, enabling applications in drug delivery systems, and tissue engineering. The controlled release of these active substances from the nanofibrous layers offers sustained and localized delivery, enhancing therapeutic efficacy while minimizing systemic side effects.

In this research, polylactide (PLA) was specifically selected as the polymer due to its biocompatibility, biodegradability, and suitability for electrospinning processes. PLA is approved by the U. S. Food and Drug Administration (FDA) [1], thereby making it an ideal choice for fabricating nanofibrous layers intended for various biomedical and pharmaceutical applications. As for the active substance, curcumin (CUR) was chosen as the model compound due to its potent antioxidant, anti-inflammatory, and antimicrobial properties. CUR has garnered significant attention in the field of biomedical research for its therapeutic potential. The similarity in solubility properties between curcumin and polylactide makes curcumin an ideal candidate for incorporation into PLA nanofibrous layers.

This research explores the application of Alternating Current (AC) electrospinning to fabricate PLA nanofibrous layers while concurrently incorporating CUR, as shown in Figure 1, A. The potential of AC technology lies in the possibility of incorporating higher concentrations of active substances and higher productivity on an industrial scale compared to Direct Current (DC) electrospinning. [2]

This study investigates the influence of electrospinning parameters on the fabricated nanofibrous layer's morphology, structure, and functionality.

A polymer solution for electrospinning was prepared by dissolving an appropriate quantity of PLA at 10 wt% in a mixed solvent of formic acid, acetic acid, and acetone (1:1:1 weight ratio) at room temperature with continuous stirring for 24 hours. After this initial mixing period, CUR was added at 0 wt%, 10 wt%, 25 wt%, and 50 wt% relative to the PLA content, and the solution was further stirred for an additional period. PLA nanofibrous layers with high concentrations of CUR were successfully produced using AC, Figure 1, and DC electrospinning technologies. The experiments yielded defect-free nanofibers consistently. For instance, in Figure 2 SEM illustrates PLA nanofibers loaded with CUR (25%) fabricated using AC electrospinning technology.

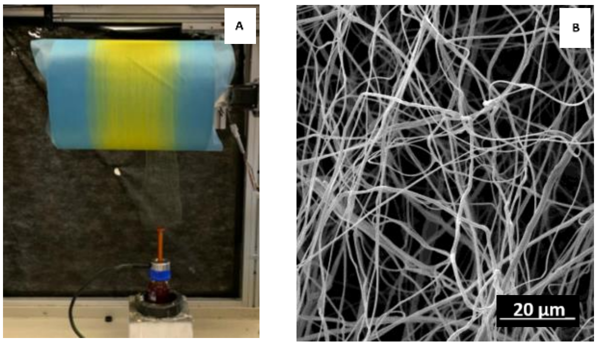


**Figure 1** Electrospinning PLA with curcumin by AC technology (A) and an image from SEM analysis of this resulting nanofibrous layer (B)

The results of this research contribute to advancing the understanding of electrospinning by AC technology for fabricating functional nanofibrous layers and elucidate its potential for diverse applications in areas such as healthcare, and beyond.

***Keywords:*** *electrospinning, alternating current (AC), drug delivery systems, polylactide (PLA), curcumin (CUR)*

**ACKNOWLEDGMENT**: *We would like to express our gratitude to the Department of Nonwovens and Nanofibrous Materials, Faculty of Textile Engineering, Technical University of Liberec, Czech Republic for their support and resources that facilitated this research endeavor. The research was supported by the Ministry of Health of the Czech Republic (Project NU23-08-00586). Special thanks are also due to Ing. Radek Jirkovec, Ph.D., to Ing. Josef Skřivánek, Ph.D. for their contributions and assistance in various aspects of the research.*

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[1] address: Dpt. of Nonwovens and Nanofibrous Materials, Technical University of Liberec, Studentská 1402/2, Liberec, Czech Republic