Electrospinning and Electrospraying
Cost-Effective and Flexible

HARKE
Pharma & Nutra

岐阜薬科大学
Gifu Pharmaceutical University



Amorphous
Solid Dispersion

Electrohydrodynamic processes namely Electrospinning and Electrospraying are cost effective and flexible methods that utilize electrically charged jets of polymer solutions for production of Nano-Fibers or Nano-Particles.

YOUR DOSAGE FORM EXPERTS

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ELECTROSPINNING AND ELECTROSPRAYING
COST-EFFECTIVE AND FLEXIBLE

Electrospinning and Electrospraying are both electrohydrodynamic mechanisms which are used for the production of nano/microfibers and nano/microparticles.

The fundamentals of both the processes are the application of an electrostatic force to produce electrically charged jets out of viscoelastic polymer solutions. Solvent is evaporated in time and nano-micro structures are obtained once the process is complete.

Some of the pharmaceutical excipients used in Electrospinning/-spraying are PVA, Cellulosics, PVP, Copovidone, PEO, EC, Shellac, Sodium Alginate, Methacrylates, Glycerol, Cyclodextrins, etc.

Advantages of Electrospinning

- Alternative to conventional processing technologies such as freeze- and spray-drying
- Single step room temperature drying and encapsulation
- Wide range of materials (polymers, bioactives, enzymes, live cells, etc.)
- Scalable from lab bench to industrial production

Electrospinning and Electrospraying are Well Established in Many Fields

Pharmaceutical

- Increase bioavailability:
  Amorphous Solid Dispersion
- Dry labile bioactives
- Encapsulate and design release profile

Nutraceutical

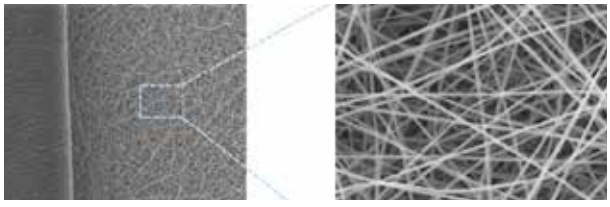
- Stabilize & protect labile materials (maximize shelf life, optimize for enteric passage and targeted delivery)
- Increase bioavailability of bioactive ingredients
- Flavor or fragrance masking



Electrospinning: Fibres



Electrospraying: Particles



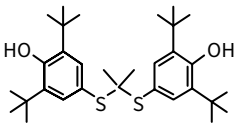
Polymeric nanofibers are several hundred nanometers in diameter, about 1/500 the thickness of a human hair.

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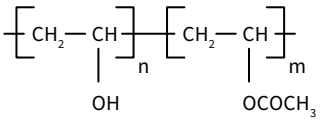
Model Substance

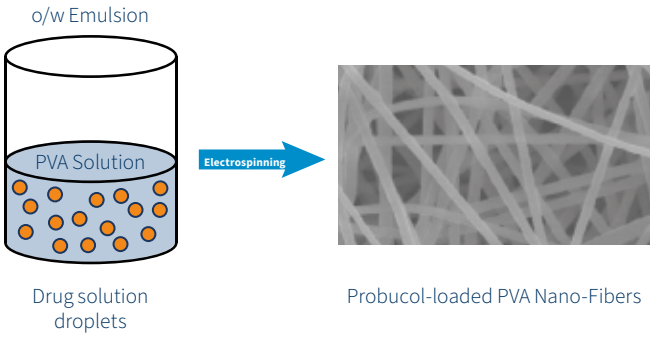
Probucol, PBC



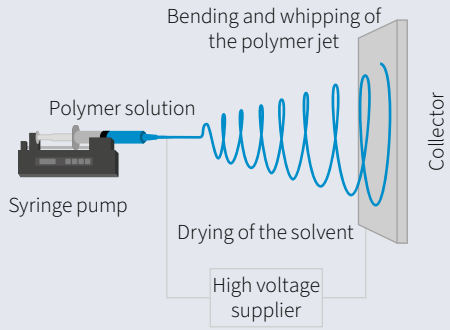
Polymer

Polyvinyl-alcohol,



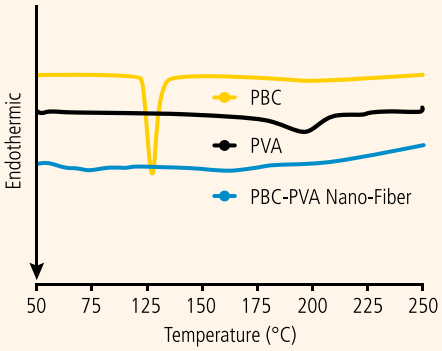


Recent studies have reported that preparing solid dispersions using PVA improved the solubility of poorly water-soluble drugs [1, 2]. Gifu University in Japan succeeded to improve the solubility of Probucol (PBC), a poorly-soluble drug by preparing an oil/water emulsion consisting of PBC dissolved in an immiscible solvent and an aqueous PVA phase.[3]

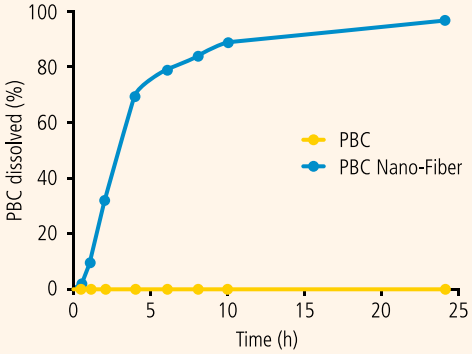


PVA nanofibers produced by o/w emulsion electrospinning were demonstrated to be suitable solid dispersion systems enabling robust controlled release of poorly water-soluble drugs. This emulsion was electrospun creating nanofibers with a diameter ranging from 300 to 600 nm.

PVA is an ideal material for preparing drug-containing nanofibers. Since the hydroxyl and vinyl groups of PVA interact with the aqueous phase and oil phase respectively, the concentration and type of PVA could affect the emulsion. O/W emulsions made up of partially hydrolized PVA (GOHSENOL™ series) showed better spinnability than O/W emulsions made up of fully hydrolized PVA.



The PBC-PVA Nano-Fiber is of amorphous nature as can be seen in the DSC-Analysis.



The solubility of PBC has clearly increased when it is formulated as Nano-Fiber.

1. Y. Mori, K. Motoyama, M. Ishida, R. Onodera, T. Higashi, H. Arima, Theoretical and practical evaluation of lowly hydrolyzed polyvinyl alcohol as a potential carrier for hot-melt extrusion, Int. J. Pharm. 555 (2019)
2. Y. Umemoto, S. Uchida, T. Yoshida, K. Shimada, H. Kojima, A. Takagi, S. Tanaka, Y. Kashiwagura, N. Namiki, An effective polyvinyl alcohol for the solubilization of poorly water-soluble drugs in solid dispersion formulations, J. Drug Deliv. Sci. Technol. 55 (2020)
3. Takato Shibata ,Nobuyoshi Yoshimura , Ayaka Kobayashi , Takaaki Ito , Kouji Hara , Kohei Tahara Emulsion-electrospun polyvinyl alcohol nanofibers as a solid dispersion system to improve solubility and control the release of probucol, a poorly water-soluble drug, J. Drug Deliv. Sci. Technol. 67 (2022)

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