Industry Day Theme # {Make In India}

UHMWPE fibers by electrospinning: Influence of solution concentration and applied voltage on the morphology

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Abstract

The High temperature solution electrospinning is used to make UHMWPE fibers at different electrospinning parameters. In order to investigate the effect of the concentration and voltage on the morphology of the fibers, four different concentration, i.e 0.5wt%, 1wt%, 1.5wt% and 2wt% and two different voltages ,i.e. 15kv and 25kv, are used to prepare the fibers. Several characterization techniques, like SEM, XRD and Rheology, are used to characterize the prepared solution and the fiber.

Introduction

The electrospinning process consists of a high electric potential in the presence of high temperature applied to a pendant droplet of a starting polymer solution to form a thin fiber. The external electrical field produces a tangential stress on the polymer solution which leads to the deformation of the droplet into a conically shaped 'Taylor cone'. The conductive solution is ejected from the Taylor cone towards the collector after the surface tension of the polymer solution is exceeded by the electrical field. The solvent is quickly evaporated while travelling towards the collector. This results in formation of solvent free nanofiber.

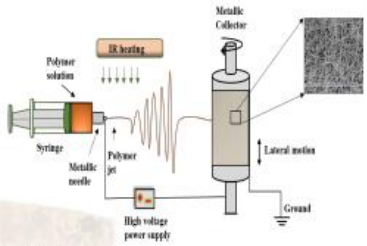


Fig. 1 Electrospinning set-up

* Factors effecting electrospinning

Materials and Methods

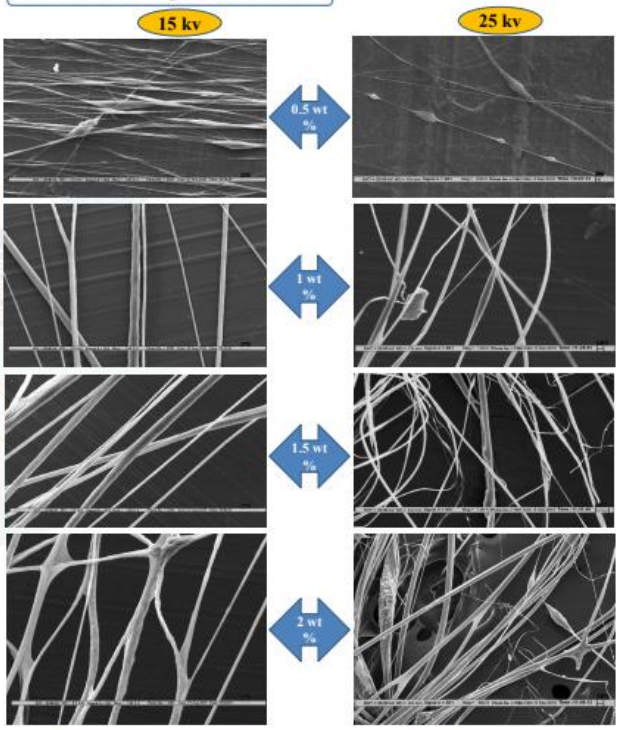
Polymer	
Solvent	Decalin and Cyclohexanone supplied from TCI Chemicals, INDIA

- The UHMWPE solution is prepared from Decalin/ Cyclohexanone in a ratio of 2:1 (v/v) at 130℃ by using hot plate magnetic stirrer for 4 hours.
- The high temperature electrospinning process is carried out using E spin Nanotech Super ES2.
- The flow rate of the solution from spinneret is maintained at 1 µL/sec.

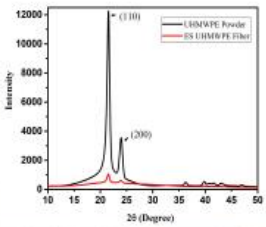
Conc. (wt. %)	Voltage (kv)	
0.5	15	25
1.0		
1.5		
2		

Results

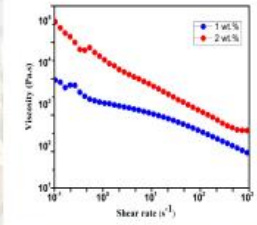
SEM at different voltage and concentration



XRD analysis



Rheological analysis



Conclusions

1. With the increase in concentration, fiber diameter distribution increases towards higher diameter of the fiber.
2. The Splitting of the fibers occurs due to solvent retention inside the fiber.
3. With the increase in voltage, fiber diameter distribution decreases.
4. The frequency of the bead formation is higher at high voltage.

Industrial Significance

This is a future performance material development for defense applications

Technology Readiness Level: 2 or 3 level

References

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