IMPLEMENTATION OF NANOFIBER FOR MANAGED DRUG EJECTION IN HUMAN

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Abstract- A coxial electrospinning method is now used to put together center-sheath nanofiber for managed drug ejection in human beings. A particular sort of co-polymer is used to managed drug release in human machine. This co-polymer is eject with the help of a new thermo-sensitive drug as a provider . The diameter of nanofiber is numerous according with the ratio of the outer flow fee to inner go with the flow price of Poly(N-isopropylacrylamide)/polyurethane middle-sheath nanofibers. To maintained the thermo-sensitivity of PNIPAAm by using adjusting the temperature of middle-sheath nanofiber. The core-sheath electrospun nanofiber with negative soluble nifedipine containing kind of polymer PNIPAAm and PU as a drug provider which gradual down the ejection charge of nifedipine as compared with the PNIPAAM/PU composite electrospun nanofibers. Through nifedipine it is successfully performed to control the drug awareness and toxicity.

Keywords- Electrospun, middle-sheath, thermo-sensitivity , outflow.

1. Introduction

Electrospinning is a superior generation that is used to manufacture the polymeric nanofibers for their miscellaneous packages in biomedical area for managed drug ejection device. Electro spun nanofiber having a different homes like length, having a excessive surface-location-to-extent ratio, porosity and many others used in drug managed ejection system. The molecule having low molecular weight including proteins and nucleic acids is encapsulated and embedded onto the fiber for managed and target transport .[1]

The middle-sheath electrospun nanofiber Poly(N-isopropylacrylamide)(PNIPAAm) middle-shell nano partical with having property of themosensitivity pull many researchers to study about it, particularly in biomedical field. Nevertheless, the fabrication of middle-sheath nanofibers from PNIPAAm is studied carefully. The chen ad his coworkers are obtain from polycaprolactone diol(PCL)/PNIPAAm middle-sheath nanofibers by using coaxial electrospinning techniques. By use the thermo-sensitive polymer with the of perishable polymer which is PCL within a middle- sheath system can be increase its ability in biomedial fields. The paper discuse the fabrication process of PNIPAAm middle-sheath electrospun nanofiber.

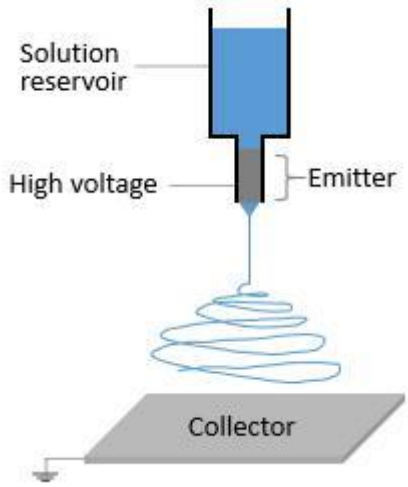

Figure.1 Electrospinning

The PCL having good parishability so it is used as a raw material to obtain polyurethane(PU) with it great advantages in medical field. PNIPAAm is present in the core part and the PU used as a sheath of electrspun nanofiber. The middle-sheath nanofiber is fabricated by changing the inner flow and outher flow rate of the coaxial spinneret. The chaterstics of the thermosensitive polymer can be affected by the contact angle (CA) of the fiber. The framework drug is used to manage the function of the middle-sheath and composite electrospinning nanofiber fot managed drug release in human system.

2. Experimental

2.1. Polymers : The monomers were used directly without purification. N-isopropylacrylamide and PCL (Mn = 2000) (TCI, Japan), isophorone diisocyanate (Alfar, USA) had been the principle elements. N, N, N′, N′-tetramethylethylenediamine (Shanghai Adamas, China) was used to accelerate reaction, and 1, 4 - butanene diol (Shanghai Adamas, China) became used to increase viscosity. PNIPAAm and PU have been each synthesised with the equal tactics as previously suggested. [2, 3]

2.2. Prolusion of elecrospun nanofibers :

In this process firstly the drug carrier upto 0.2738g is dissolved in 3 ml of N,N-dimethylformamide(DMF) With 0.3412g of PU. After that this solution is simulated for 4 hours at a 22 degree C temperature. At the end the co-polymer about 30% was add in the solution of PNIPAAm/DMF.[4]

The syringe containing the solution of PNIPAAm and PU which is connected to a coaxial spinneret having an internal diameter of 0.51mm and outer diameter is about 0.82mm.

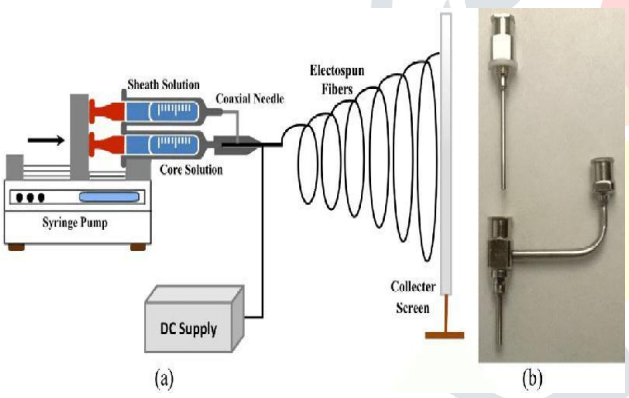

Figure.2 setup of coaxial electrospinning

Now the solution is fed into a special type of syringes having 5ml volume .A high voltage about 15kv is applied at the tip of the spinneret so the solution is charge with the electro static charge and then the pressure create at the tip then it eject the nanofiber at the rotation collector (as shown in figure 2). The electrospinning technique is done with its specific parameter: the flow rate of sheath and core solution is about 2:1, 3:1, and 4:1. The distance should be maintain between the syringes and the collector is about 22cm.[4]

2.3. Measurements of electrospun nanofiber:

The electrospun nanofiber which is collected from collector plate is cut into small pieces. The image can be obtain by using scanning electron microscopy(SEM) which which we can obtain the outer image of nanofiber. The inner image of electrospun nanofiber is obtain with the help of Transission electron microscopy(TEM). The SEM and TEM analysis is obtain at different voltages at 20kv and 100kv. Here the TEM need more voltage to charge the electron which is penetrate the electrspun nanofiber.

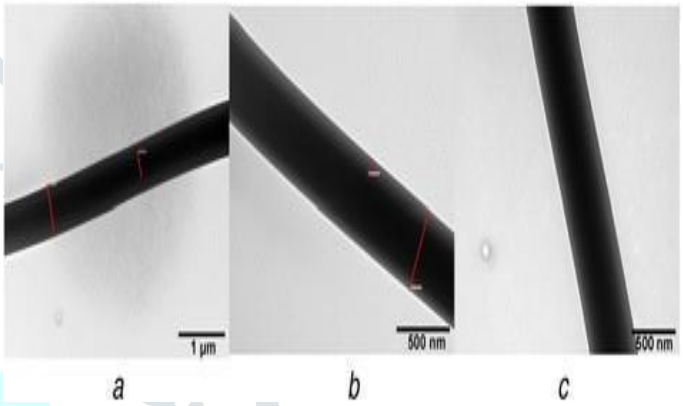

Figure.3 TEM microscopy with different outer/inner flow rate ratio

3. Results

3.1. Morphology result of PNIPAAm/PU middle- sheath nanofiber :

The diameters of elctrospun nanofiber can be obtain by using Image J software . By increasing the volume of the solution we can also increase the outer flow rates without changing the inner flow rate. The flow rate is increase with increasing the diameter of the nanofiber. If the outer flow rate is more than expected then the spinneret will block the flow and the taylor cone is equal, so the diameter of the nanofiber will not change.

3.2. Thermo-sensitivity of nanofiber :

In the electrospinning the drug carrier shows the property of thermo-sensitivity. It gives the great information about

nanofiber inside any body. PNIPAAm is present in the inner part of thr middle sheath nanofiber. When the goes down below low critical solution of PNIPAAm which is 24 degree C, (as shown in figure 4) At that temperature the molecules may pass through that the outer layer of the middle-sheath nanofiber. The hydrogen bond is formed with PNIPAAm. When the temperature increase the molecular chain between water and PNIPAAm starts shrank and the result of that is nanofiber become more compact because the water molecule around PU not form hydrogen bond.[4]

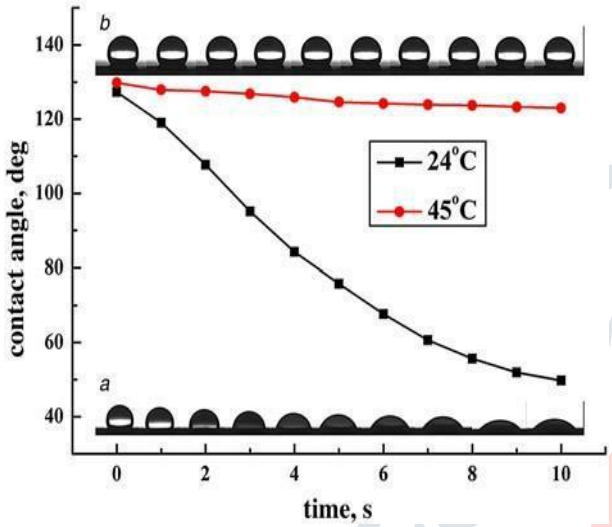

Figure .4 effect of temperature with respect to time

3.3. In-vitro release of co-polymer :

Nifedipine is used as a co-polymer in solution of PNIPAAm and PU. In PNIPAAm/PU composite nanofiber at the starting contains equal amount of solution before electrspinning, due to this the starting release of nifedipine from the composite nanofiber is slow then the middle-sheath nanofiber. The outer layer containing PCL with PU could slow down the rate of nifedipine. Thus, the middle-sheath nanofiber as a carrier of nifedipine managed the ejection rate (as shown in figure 5).

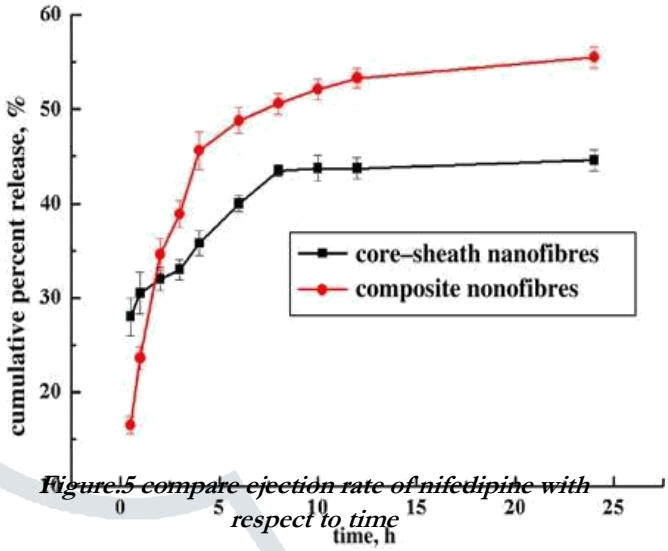

Figure.5 compare ejection rate of nifedipine with respect to time

4. Advantages

In this paper we discus about the properties of the nanofiber and its applications in biomedical. Now there is a some advantages and disadvantages of of nanofiber which is obtain from electrospinning. The electrospinning used in medical as well as in the industries . There are some following advantages of electrospun nanofiber.

The nanofiber use its property that the surface area of the nanofiber is more than its volume. Therefore, the nanofiber have small size so it can fit easy in any component or implement easy in studied about it and make it more effective for human purpose and in other field human system. Because of its surface area many medical colleges used and implement in many other fields.

The other best advantage of electrospinning is that we can use variety of polymers and monomer in many developing field such as more producing energy field to make battries etc. In this paper we only talk about biomedical field such its high porosity and viscocity it can be implement in human body. It is used in many medical field such as it is used in tissue engineering to make tissue which are not generated in human body. The electrospinning is also used to prevent from cancer and block the bacteria to effect our body system.

The next adavantage is that it can degrade easy and not harm the body. Many medical medicine affect the body due to its non degradable property.

Due to its low requirement of electrospinning its provide a plat from that we can experiment of mixing the different different polymer and monomer to obtain a balance and non overdose medicine.

The electrospinning nanofiber is not only used in biomedical field it will also used in clothing industries to make clothes according to our design. The nanofibers are also used in engineering and technology field such as to make capacitor and batteries etc.

Despite the coaxial spinneret, the capillaries for this purpose are located factor by meas of the usage of element and polymer solutions absolutely come into bodily contact on the cease of the spinneret tip. The fabricated fibers advantage from each intrinsic houses of the 2 polymers, concurrently. For example, one in every of the factors is capable of soak up chemical materials, while the alternative side is capable of electric wearing out.

5. Disadvantages

Now, a days many new technology emerging in the market. Electrospinning is the basic technique which we used in the biomedical but the draw back of this technology is that it is very costly. The distance between collector and taylor cone should be 22cm .We cannot provide the voltage > 20kv. The electrospinning process should be done with the special care on a specific environment. This technology not used in every country due to its high cost for the medical uses. The limitation of that technology that we cannot use it for multiple target in our body .

We cannot use more than 3 spinnret in the pump where the solution is persent. The technique which is used for nanofiber is not available in many country and the appilication of this technology.not used in proper way in the biomedical field. The other draw back of that technology is the temperature of human system is not maintain at the time of illness so at that time it will not work.

6. Other techniques of fabrication

The electrospinning nanofiber not only produce by the coaxial electrospinning technique it can also obtain from other ways or we can say that from other technique. Due to its uses in many application we can only used the basic technique or suitable technique to produce electrospinning nanofiber. By changing the needle or other type of solution gives us an idea of creating a new type of fiber with its unique properties and applications.

There are three types of eletrospinning techniques are available in maket they are coaxial electrspinning which we used in paper and the other are emulsion electrospinning , melt electrspinning.

Emulsion electrospinning :

In coaxial electrospinning we can used different spinneret to obtain a specific solution for the unique property of nanofiber used in different applications.

But in emulsion electrospinning is used to obtain the middle shell of the and composite nanafiber without changing its needle . This process is very difficult to obtain nanofiber as compare to coaxial electrospinning because of in this process many complex component are required to obtain the emulsion. In this process an non soluble solvent is mixed with the water and with an agenent to obtain emulsion.

Melt electrospinning :

In this process we used to melt the polymer at a specific temperature through this the volatile solvent is eliminate from the electrospun solution. In this type of process we use semi crystalline polymer is used to obtain the fiber . The best example of the melt electrospinning this type of material which we use in our daily life which is plastic.

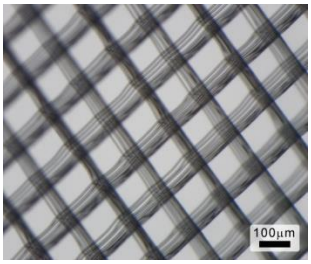

Figure .6 melt electrospinning

The melting electrospinning is similar to coaxial electrospinning through which we use the high voltage at the spinneret and the collector. In this the polymer is generally obtain from resistence heating or lasers.

7.Conclusion

The middle-sheath nanofiber is successfully obtain with its some specific parameter. Thus, the PNIPAAm is a great drug carrier with out failure . The thermo- sensitivity property gives the idea that how below LCST(24 degree C) not work of the PNIPAAm and it should be increase its water resistance with increase the temperature above LCST(45 degree C). When we compare both composite nanofiber with middle-sheath nanofiber as a drug carrier gives a result that the both could achieve the slow down rate of nifedipine . In this paper we obtain many advantages and disadvantage of electrospinning nanofiber. Many other process is used to produce elctrospinning instant of coaxial electrospinning.

8. Reference

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