Development of nano carriers for drug delivery applications

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ABSTRACT

Research areas, such as drug delivery systems, have attracted much attention in recent years due to the numerous possibilities of curing cancer. This study aims to fabricate nanocarriers by using biodegradable and biocompatible polymers for controlled release in drug delivery applications. Chitosan and PLGA polymers were used to fabricate thin films and diffused to AAO templates to have polymer 1-D nanocarriers for targeted delivery applications which are temperature and pH-responsive polymers. Depending on the pH or temperature of the environment, these polymer nanocarriers swell or shrink. This property prepares the drug to reach their targeted area more effectively.

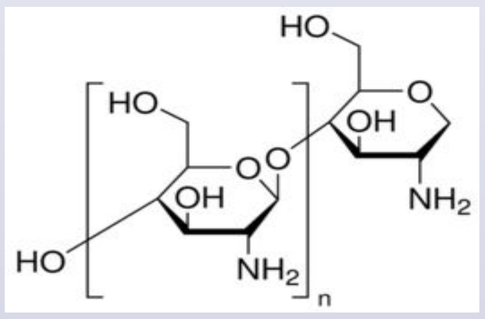

Figure 1: Chitosan Formula

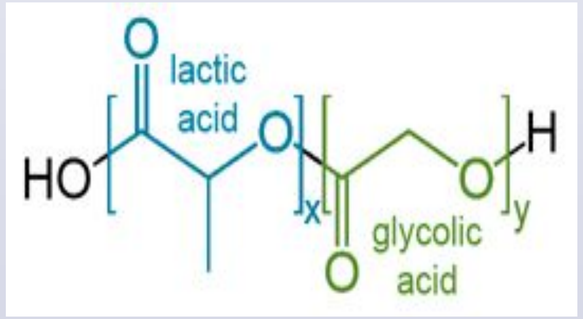

Figure 2: Poly lactic-*co*-glycolic acid formula

OBJECTIVE

Objective of this project is fabricating nanocarriers by using biodegradable & biocompatible polymers for drug delivery applications.

THEORY

For targeted drug delivery systems, it is very crucial to utilize biodegradable and biocompatible polymers. In this project chitosan and PLGA is selected due to there nature. [1,2]. Nanocarriers from polymers have been fabricated by template wetting method, so as to utilize carriers as drug containers in a controllable manner. [1] Template wetting is a widely used method in order to produce nanofibers or nanotubes in highly ordered uniform orientation. In the process, templates like AAO(anodic aluminum oxide) can either be wet by a solution or solution is placed on a substrate with high surface energy, it will spread to form a thin film, then, film will cover the pore walls in the initial stages of wetting. In order to coat flat substrates withthin films spin coating method is applicable.A small amount of solution is dropped on the center of a substrate then spin coater starts to spin, because of centripetal acceleration it leaves a thin uniform film on the surface.

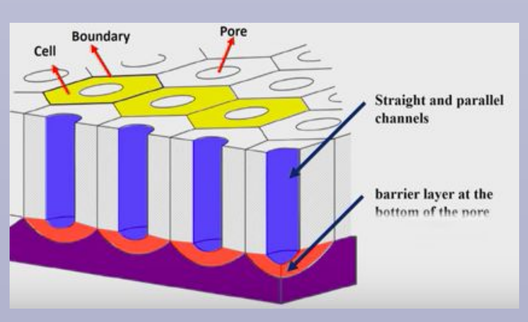

Figure 3: AAO Templates

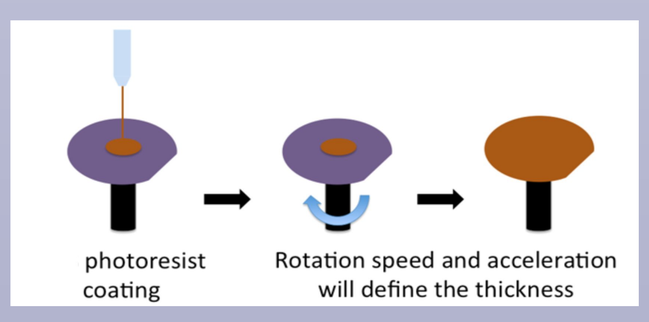

Figure 4: Spim Coating Technique

RESULTS

Table 1: Elipsometer results for thickness of (a) Chitosan, (b) PLGA solution

a)

Sample No	Sample Amount(µL)	Speed(rpm)	Time(sec)	Concentrtion(wt%)	Thickness(nm)
1	100	3000	30	1	31.31
2(x3)	100	3000	30	1	51.44
3	200	3000	30	1	17.32
4	200	5000	30	1	43.16
5	200	3000	60	1	47.12

b)

Sample No	Sample Amount(µL)	Speed(rpm)	Time(sec)	Concentration (wt%)	Thickness(nm)
1	100	2000	60	0.93	126
2	100	3000	60	2	325
3	100	2000	30	0.93	155
4	75	2000	30	0.93	137
5	100	3000	60	2	111

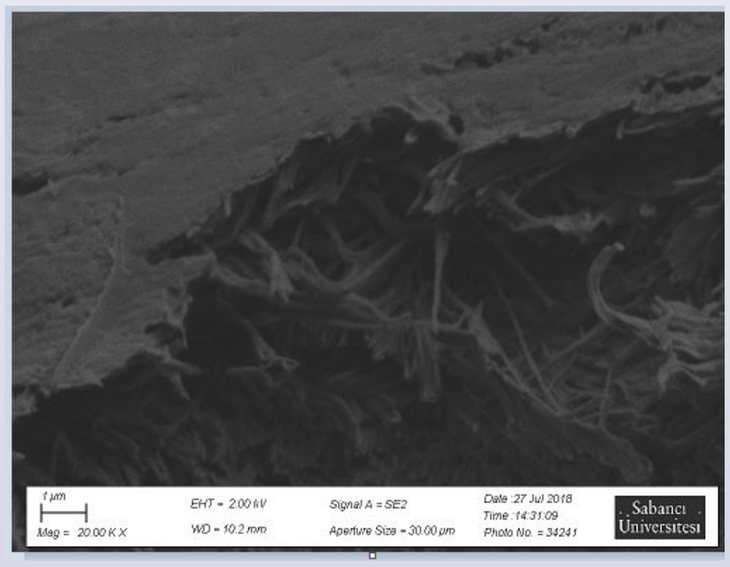

Figure 5: SEM results of 2 wt%Chitosan solution after etching AAO.

Figure 6: SEM results of 2 wt% PLGA solution after etching AAO.

CONCLUSION & FUTURE WORK

- Both PLGA and chitosan films obtained
- Thickness of films measured by ellipsometry
- Template wetting method applied by using AAO templates
- At the end 1D nanocarrier structures obtained
- Determining the nanocarrier structure SEM (scanning electron microscope)

As for the future work;

- ibuprofen will be loaded on nanocarriers
- the kinetics of drug release will be determined by using FT-IR and UV-Vis
- multilayer fabrication to achieve delayed drug release for targeting the tissue

REFERENCES

[1]Dougherty, S., & Liang, J. (2008). Fabrication of segmented nanofibers by template wetting of multilayered alternating polymer thin films. Journal of Nanoparticle Research,11(3), 743-747. doi:10.1007/s11051-008-9502-0

[2]A review of chitin and chitosan applications. (2000, November 08). Retrieved from https://www.sciencedirect.com/science/article/pii/S1381514800000389

[3] Makadia, H. K., & Siegel, S. J. (2011, September 11). Poly Lactic-co-Glycolic Acid (PLGA) as Biodegradable Controlled Drug Delivery Carrier. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3347861/