# Hydrogels Films with CNTs for biosensing applications

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## ABSTRACT

Hydrogels have been probe to be an amazing material, we present and hydrogel that we formulated with a mix of carbopol 940 and PVA, the selection of this material is because they present a high level of compatibility with biological environment. Multiwall CNT that we obtained from Nanotechnology Lab of the Iberoamericana University, after the functionalization of the CNT, were mixed with the Carbopol and PVA Solution to obtained a film of Hydrogel with CNT. For the characterization, we use determine %Swelling. The purpose of this method is utilized the film as a biosensor for bacteria detection or as a drug delivery devices. Also, we could introduce this film in a microfluidic device to probe that can be use a biosensor.

***Keywords***: PVA, Bio sensing, Carbopol

## 1 INTRODUCTION

Natural base polymers have been a novel material and their applications in biomedical industries are rapidly growing [1], for example in the develop of point of care devices can be used for sensing a different kind of pathogens. Also, the properties of the hydrogel as the swelling, and biocompatibility, can be significant to make a matrices trap for biological material.

If nanoparticles as multiwall carbon nanotubes(MCNT) are mixed with the hydrogel, to enhance the properties of the polymer and have the selectivity for a specific detection [2].

## 2 MATERIALS AND METHODS

PVA of grade 125 were obtain from thins films laboratory of Iberoamericana University, Carbopol 940 and gelatin were purchased from Cosmopolita Drug-store, distilled water was use in the preparation of the hydrogel, Ethanol 200 were purchased from Sigma Aldrich México. CNTs were prepared by CVD Method with an outer diameter of about 65nm to 70nm. Before use, the CNTs were functionalized with a mix of $H_2SO_4$ and distilled water (1:3 v/v) for about 5 hours in a combination of stir an ultrasound cleaner (15min/30min) [3].

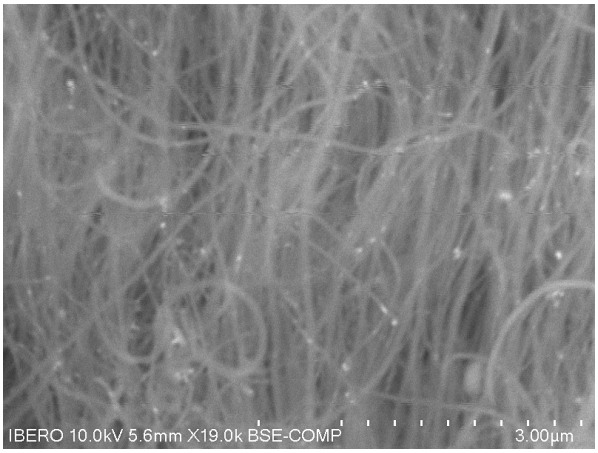


Figure 1: CNTs after the functionalization in SEM

For PVA hydrogels a 10% aqueous solution was prepared by heating and stirring the solution for 1hour and the 2.5g of gelatin were dissolved in to the solution. This for the first experiment [4]. For the second experiment, we used the same solution, and dissolved 2g of carbopol 940 and stir for 45min. 5mg of CNTs were mix in 100ml of PVA and carbopol solution. Then were poured in a petri dishes with 10cm of diameter. The hydrogel films were let dry at room temperature in a desiccator for 48 hrs. as show in the figure 2.

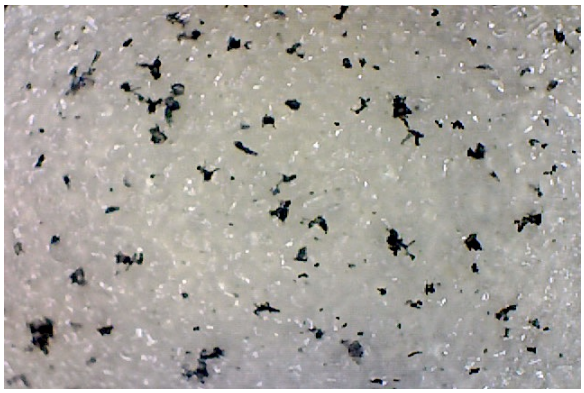

Figure 2: film with CNTs.

The swelling behavior of the hydrogel was measured in distilled water at room temperature for 24hrs. Then the films were remove and the swelling were calculated by using the equation:

$$Swelling\ (S) = \frac{W_s - W_d}{W_d} \quad (1)$$

Where, $W_s$ is the weight of the hydrogel in swollen state, $W_d$ is the weight of the hydrogel in dry state [5].

## 3 RESULTS AND DISCUSSION

The next table present de results of the swelling measured:

| Hydrogel Film | Swelling ratio |
|---|---|
| PVA | 3.16 |
| Carbopol | 38.02 |
| PVA+CNT | 4.27 |
| Carbopol+CNT | 39.22 |

Table 1: Swelling Behavior results

This results show that the carbon nanotubes increased this mechanical property in both case. The difference between cabopol and PVA where because the portion of carbopol films were bigger than PVA films.

The increased of the swelling ratio means that the matrices size are increase so it is more suitable for a trap for different biological material. Aptamers can be added at CNTs for specific bacterial detection.

## 4 CONCLUSIONS

A study of how CNTs can improve the swelling property in a hydrogel film was successfully been demonstrated. The swelling ratio were increased in 70% with a 5% concentration of CNTs. We demonstrate that the size of the matrices can be modified with the CNTs.

This property make that the film could be use in a microfluidic device to run test for looking pathogen bacteria's, also with the proper concentration of CNTs, the matrices can be modified to trap small particles in water like medicine waste or for detect the presence of a heavy metals.

The films are suitable for packs of meals and detect if the food is still in a good way for human consumption.

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