

Incorporation of Chlorhexidine in thin polymeric films deposited by plasma technique from the monomer 2-methyl-2-oxazolyne

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INTRODUCTION

Plasma polymerized (pp-) thin films, are usually very adherent to any type of substrate and do not dissolve in mild acidic and basic media. Thus, polymers obtained by plasma from biocompatible monomers are very promising in the biomedical industry. One interesting kind of polymers are the poly-oxazolines, which are known for their biocompatible properties, they are protein-resistant, hydrophilic and have "stealth" properties [1,2]. They are usually obtained by ring-opening polymerization, however, new techniques are being used for it, such as plasma polymerization [3,4]. In this work, the chosen precursor for this pp-oxazoline film was the 2-methyl-2-oxazoline (MOXA). The wettability, molecular structure and thickness of the films were characterized.

One interesting application for thin polymeric films is using it as drug carries to promote regular and localized release of medicine in the body [5,6]. The chlorhexidine is an antiseptic largely used in odontology, it is bactericide and antifungal. The incorporation of this kind of medicine in a polymeric thin coating might be interesting for infection control in in-vivo implants. The surfaces treated with chlorhexidine were evaluated by its wettability and molecular structure.

I. EXPERIMENTAL SETUP

A stainless steel parallel plates reactor was used to deposit biocompatible nanometric thin polymer films by plasma, derived from MOXA monomer, the system was maintained at a low pressure and radio frequency power ranged from 5 to 20 W was applied for the deposition. The monomer was mixed with argon inside the chamber, the partial pressure was 50 and 30 mTorr respectively and the deposition time was 1 hour. The emission spectra of the plasma during the deposition was taken by optical emission spectroscopy (OES).

To promote the drug incorporation, samples of all depositions conditions were dipped in chlorhexidine 2% for 30 minutes. Later, the samples were flushed in compressed air and stored for 24 hours to dry.

The molecular structure analyses were done by FTIR spectroscopy, the spectra were collected by a Perkin Elmer Spectrum 100 FTIR spectrometer in the spectral range from 4000 to 650 cm^{-1} . The contact angle measurements were performed by using a goniometer Ramè Hart - 300 F1. The thickness measurements were performed by confocal microscopy using a Leica DCM3D microscope.

II. RESULTS AND DISCUSSIONS

It was observed influence on the deposition rate of the films, from 120 nm/h to 460 nm/h as the power increase from 5 to 20W, as shown in figure 1.

All the deposited films were hydrophilic, with contact angles around 20 degrees, regardless the deposition applied power and remained like this after the chlorhexidine incorporation. In figure 2 one can see the infrared spectra for the films deposited from 5 to 20W before and after chlorhexidine incorporation, it is possible to note that the molecular groups present in the film are the same regardless the applied power during deposition, however, the ratio between peaks might change. Changes in functional groups related to the chlorhexidine were observed in the infrared spectra after its incorporation, essentially C-C ($1450\text{-}1512\text{ cm}^{-1}$), C=N ($1600\text{-}1670\text{ cm}^{-1}$) and phenyl group (1550 cm^{-1}) corroborating the presence of the medicine in the film. The OES of the plasma was measured and peaks relative to C-N (382-388 nm), C-H (431 nm), N-H (337 nm), NH_2 (516 nm) was observed for all power conditions, however, they all increase when the power rises.

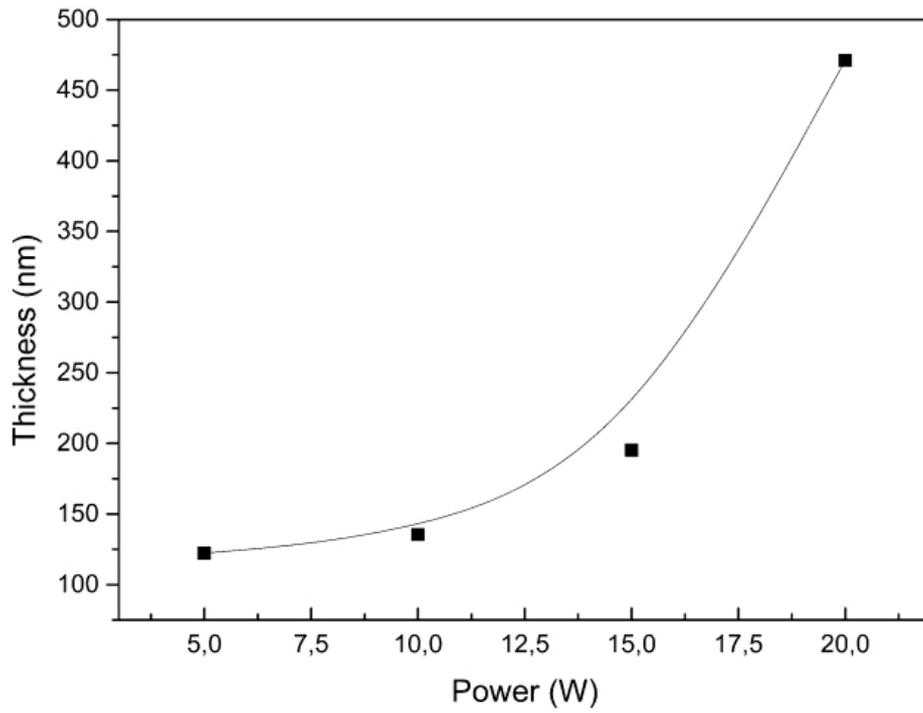


Figure 1 Thickness of PMOXA deposited by plasma in different applied power conditions.

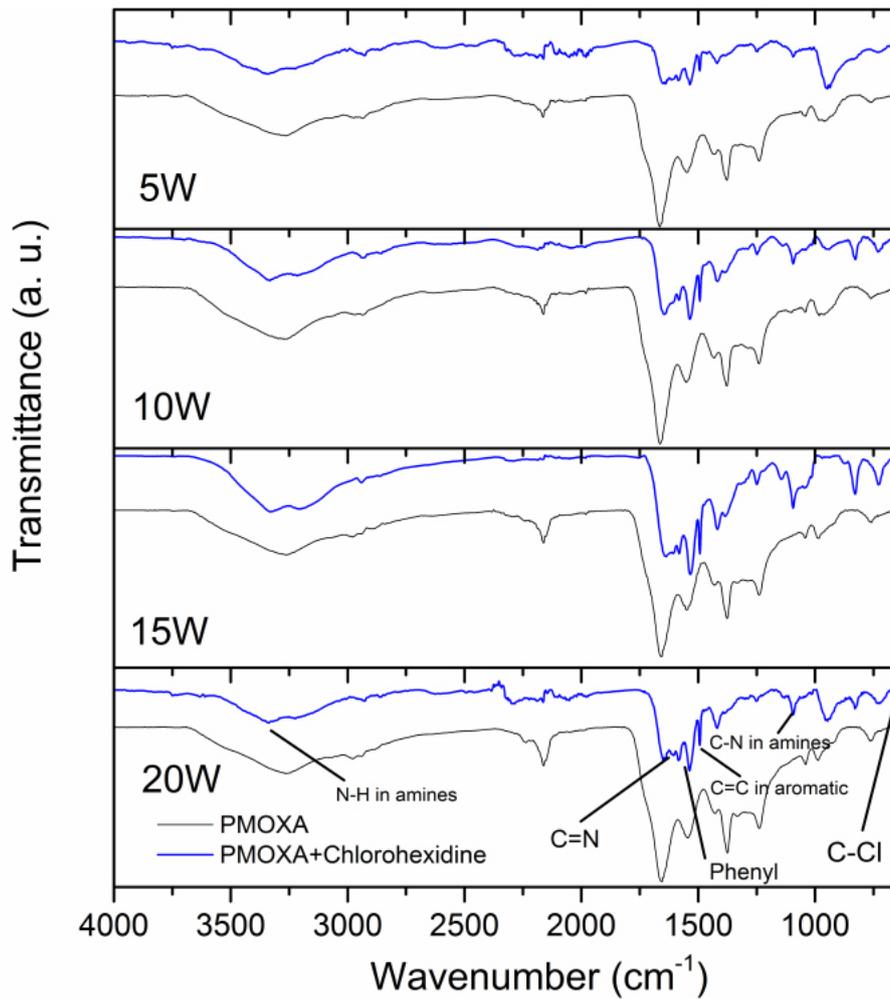


Figure 2 FTIR spectra of PMOX films deposited with 5 to 20W before and after chlorhexidine incorporation.

III. REFERENCES

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