FABRICATION OF CA/CS COMPOSITE FILMS BY SOLUTION BLOW SPINNING METHOD FOR FOOD PACKAGING APPLICATION

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Group of Polymer Composites and Interphases

GMCPI

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Introduction

This project aims to produce composite films from cellulose acetate (CA) and chitosan (CS) bio-polymers, which have excellent properties as eco-friendly, biodegradable, biocompatible, and natural benign materials and therefore good candidates for being used in food packaging [1].

Cellulose is one of the most abundant and significant biopolymers on the planet while cellulose acetate (CA) is a derivative of cellulose that is produced by esterification. CA is biopolymer highly soluble in the majority of organic solvents and mild mineral acids, having also excellent film-forming properties. Films obtained from CA have good transparency and mechanical properties which allows them to be used for food packaging [2].

Chitosan (CS) is a renewable material derived from chitin from various sources, including prawn shells and fish. Chitosan is a biopolymer that possesses exceptional properties, including antimicrobial and non toxic properties. In the last few decades, chitosan's use in the packaging industry has gained attention. Chitosan is dissolved in diluted acidic solvents [3].

In this work, composite films are produced via **solution blow spinning (SBS) method**. This technique is based on the use of a concentric nozzle connected to high-pressure air supplier, which enables the production of polymer-based flat films or nanofibers. All materials for this work were prepared using an automatic device designed and made by the UC3M's Group of Polymer Composite Materials and Interphases [4].

Experimental: materials and methods

Preparation of polymer solutions:

- CA powder (Mn ~ 30000) and CS of low molecular weight, poly(D-glucosamine) were supplied by Sigma-Aldrich. Formic acid, FA (Panreac, 85% purity) was used as solvent.
- Before SBS, CA (8% w/w)+CS (0.2; 0.4 and 0.6% w/w) were dissolved in acid solutions of FA (85%) so that the final SBS materials had CA/CS weight ratios of 2.5, 5.0 and 7.5 % in terms of CS.

SBS Conditions:

- Injection rate 0.12 ml/min.
- Working distance (nozzle-collector) 15 cm.
- Collector rotation speed 250 rpm.
- Air pressure: 1.5 bar.

Characterization

Porosity was calculated using method described in literature [5] where apparent density of produced films was compared with the bulk density of polymers in a mixture. Wettability was evaluated through water contact angle measurements upon contact of the material's surface with a water drop immediately in (0) second and morphology analysis with field emission scanning electron microscopy (FESEM).

CA/CS — Formic Acid — Soluble

Table 1. Sample codes of materials prepared by SBS.

Sample code	wt % CS
CA	0.0
CA/CS 2.5%	2.5
CA/CS 5.0%	5.0
CA/CS 7.5%	7.5

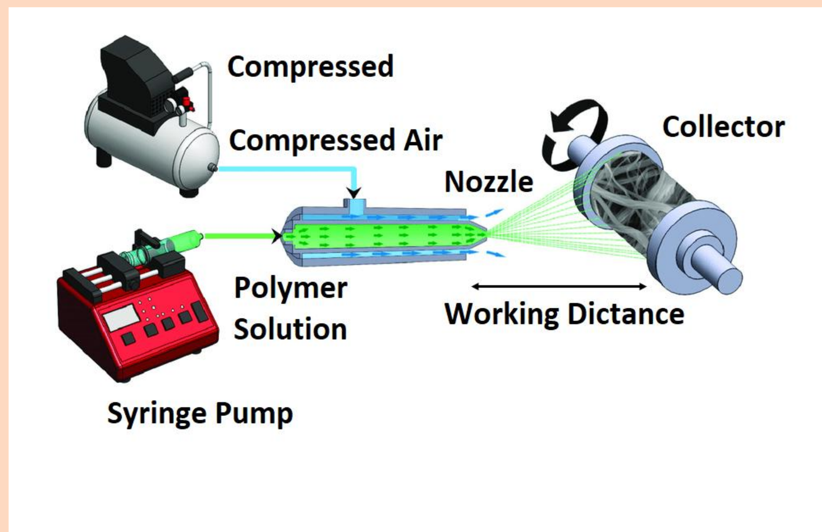

Figure 1. The components of solution blow spinning device developed at UC3M

Morphology

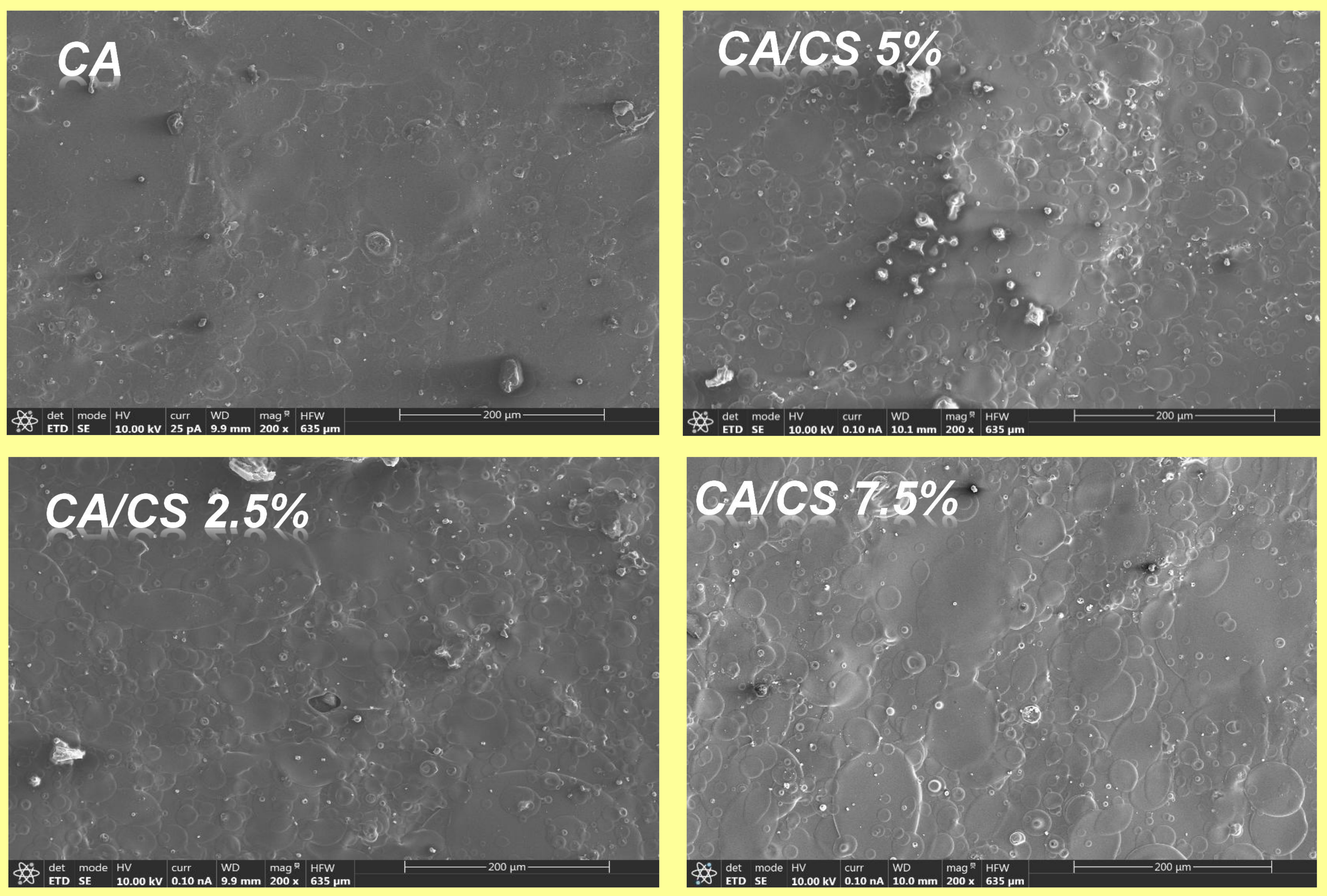

Figure 2. Scanning electron microscopy of the surface of films

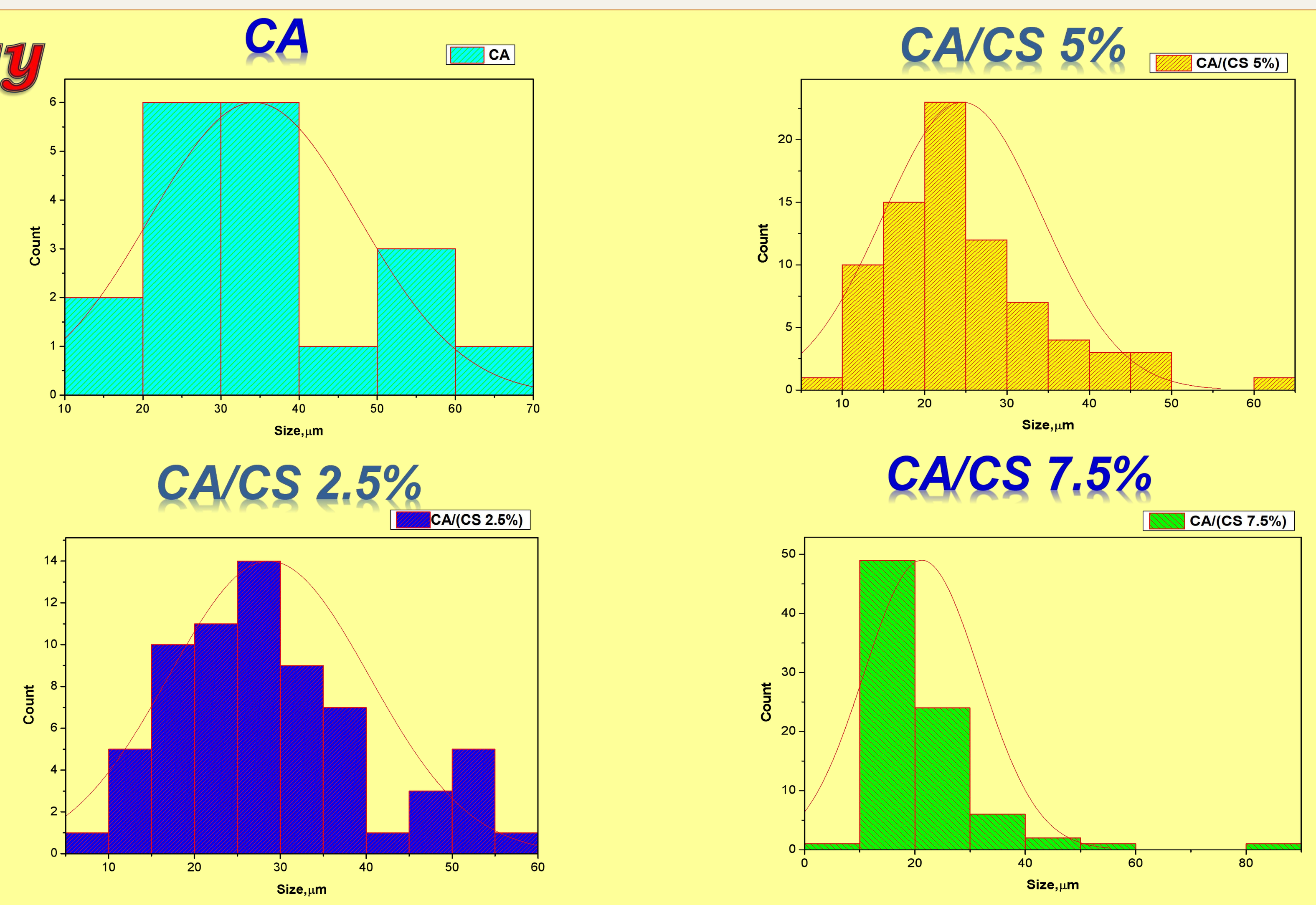

Figure 3. Size distribution of coalescent polymer droplets which constitute films surface

Wettability

Porosity

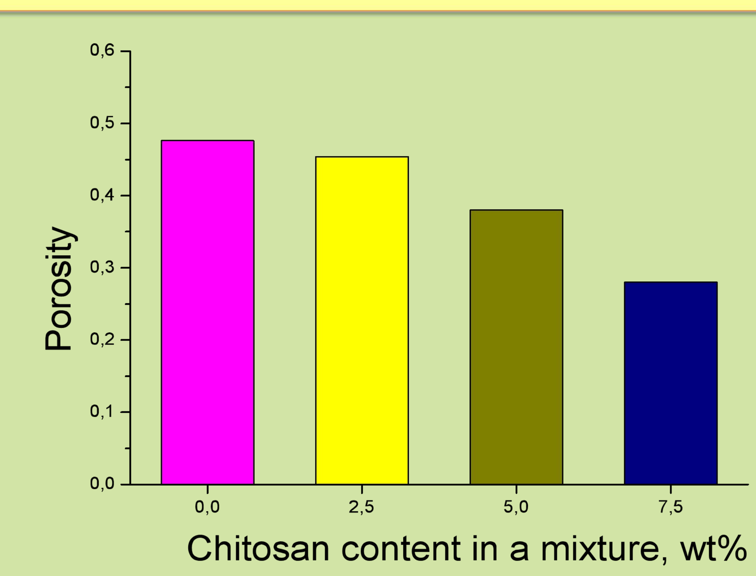

Figure 4. Porosity of films produced by SBS of polymers in formic acid

Conclusions

We have prepared composite films made of cellulose acetate and various amounts of chitosan (2.5%, 5%, and 7.5%wt), which substantially affects their resulting porosity, wettability, layer and particle formation. It has been demonstrated that adding CS to CA substantially increases its hydrophobicity and polymer droplets. These porous and hydrophobic coatings can prevent the negative effects of moisture and bacterial growth, making them a highly desirable choice for food packaging.

Acknowledgements

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