



Universidade do Minho
Escola de Engenharia



DEVELOPMENT OF ANTIMICROBIAL POLYESTER FABRIC BY A GREEN IN SITU SYNTHESIS OF COPPER NANOPARTICLES MEDIATED FROM CHITOSAN AND ASCORBIC ACID

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Introduction

Textiles are subject to a range of microbial challenges



Medical
problems

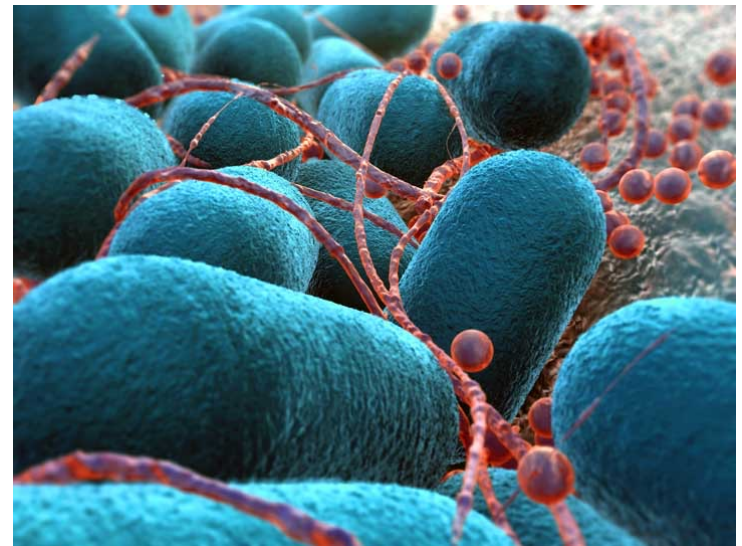
Hygienic
problems

Undesirable
aesthetic
changes

Damage in
physical
properties



Antimicrobial Finishing



Ecotextile.com visited on 03/09/2021

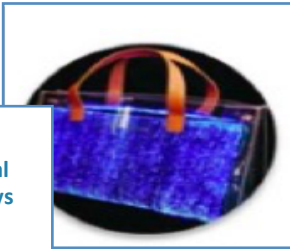
Benefits of Antimicrobial Textiles

- ✓ **Prevent the Absorption of Odors**
- ✓ **Require Fewer Washes**
- ✓ **Prevent the Dissemination of Pathogens**
- ✓ **Prevent Skin Allergies**
- ✓ **Generate Longer Product Life**

Introduction

Nanotechnology in Textiles

Optical displays



Computing



Sensors



Wrinkle resistance



Strength enhancement



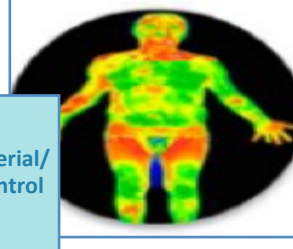
UV blocking



Water repellence



Antibacterial/
Odor control



Anti-static properties



Introduction

Metal Nanoparticles

Unique Chemical and Physical Properties

Selenium

Platinum

Gold

Palladium

Iron

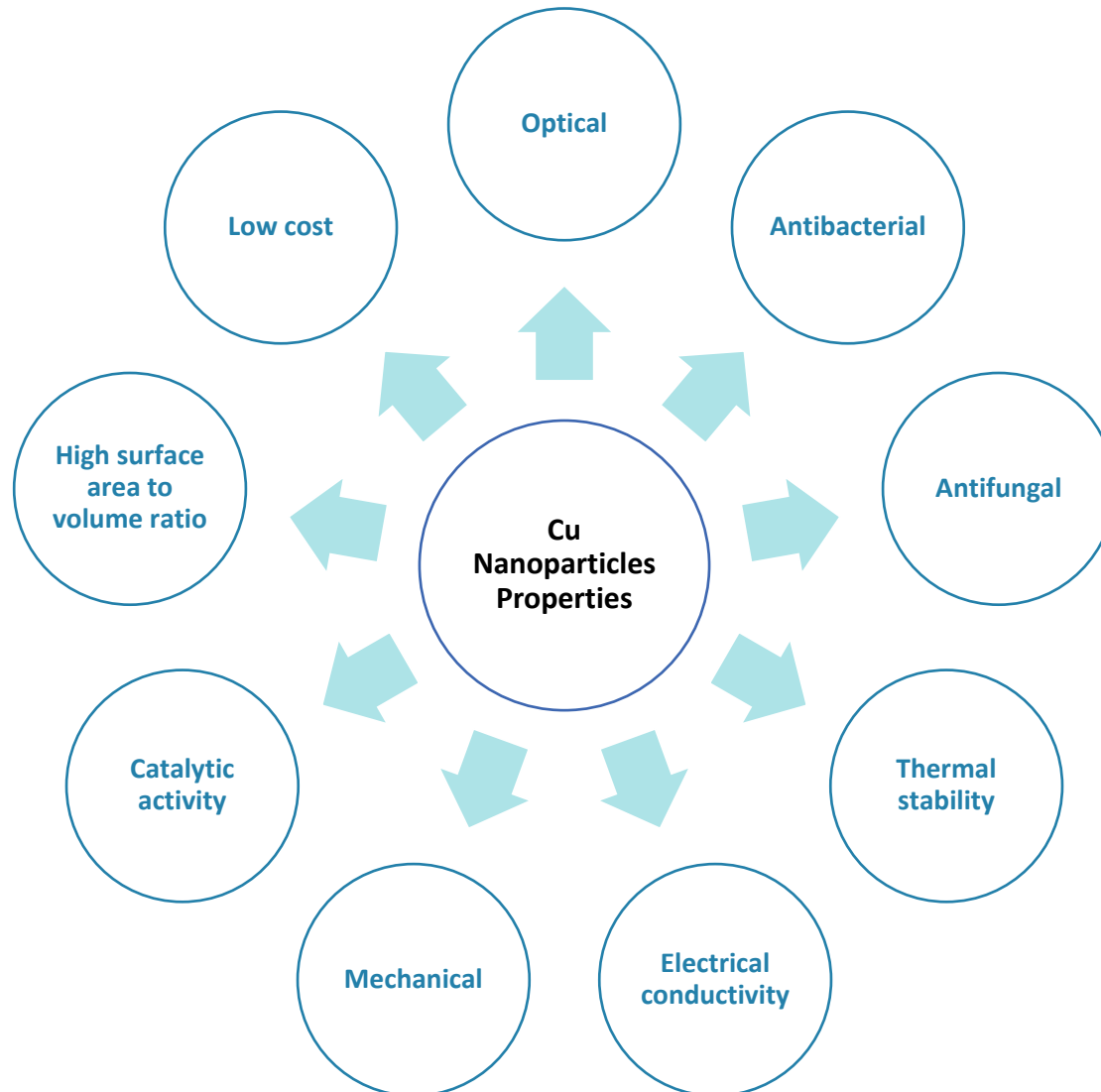
Zinc
Oxide

Silver

Copper

Introduction

CuNPs Advantages



Introduction

CuNPs Disadvantages

Inherent Instability

Prone to Oxidation

Agglomeration

**Toxicity Depends on the
Concentration**

**Synthesis with Toxic
Chemicals**

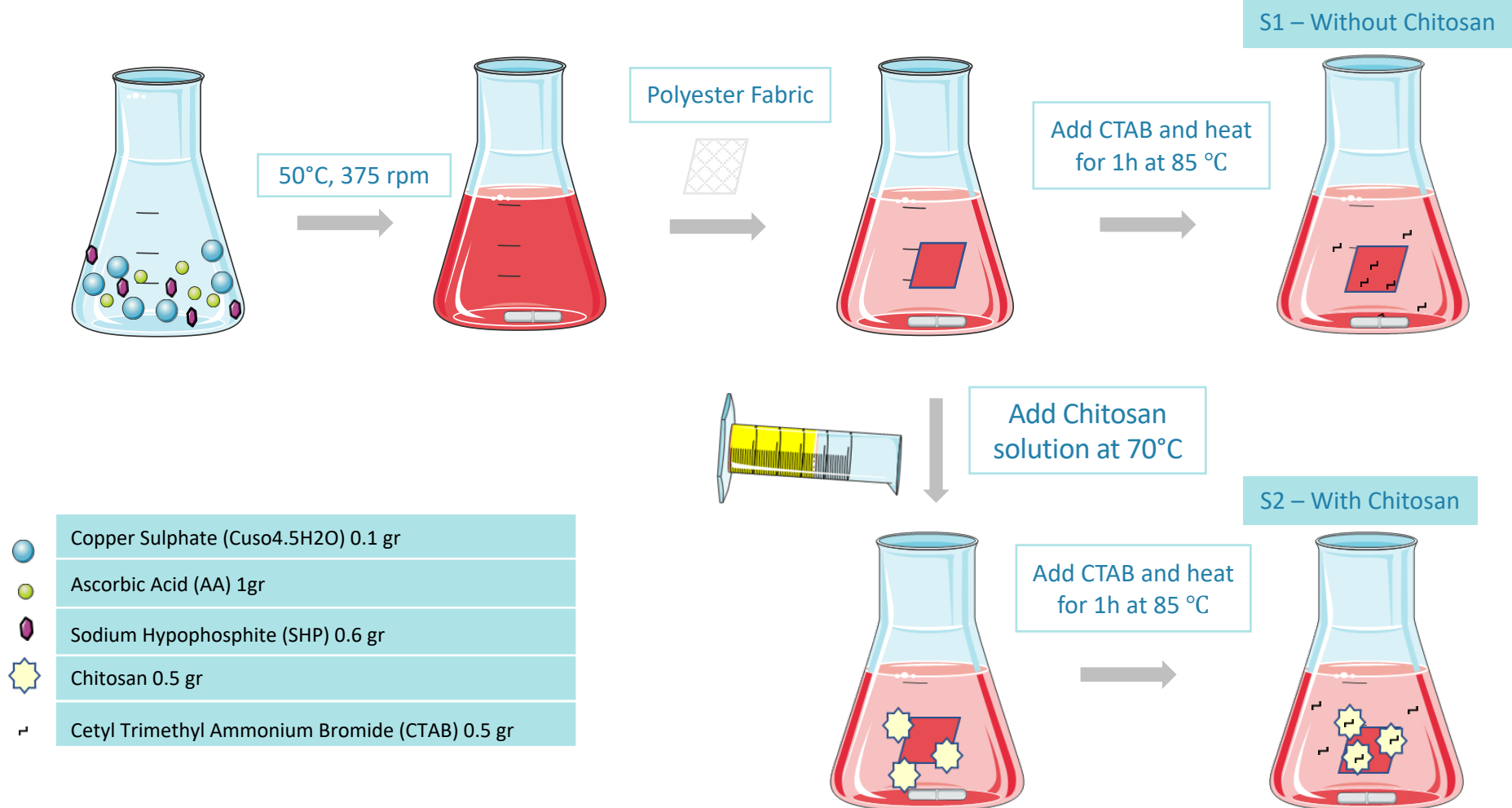
Introduction

The development of efficient and safe methods for the CuNPs synthesis and their stabilization onto surfaces is crucial.



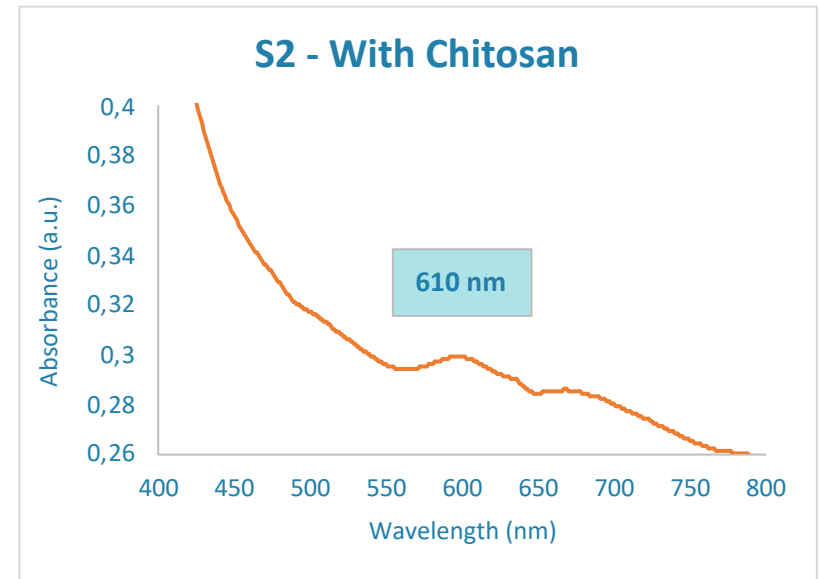
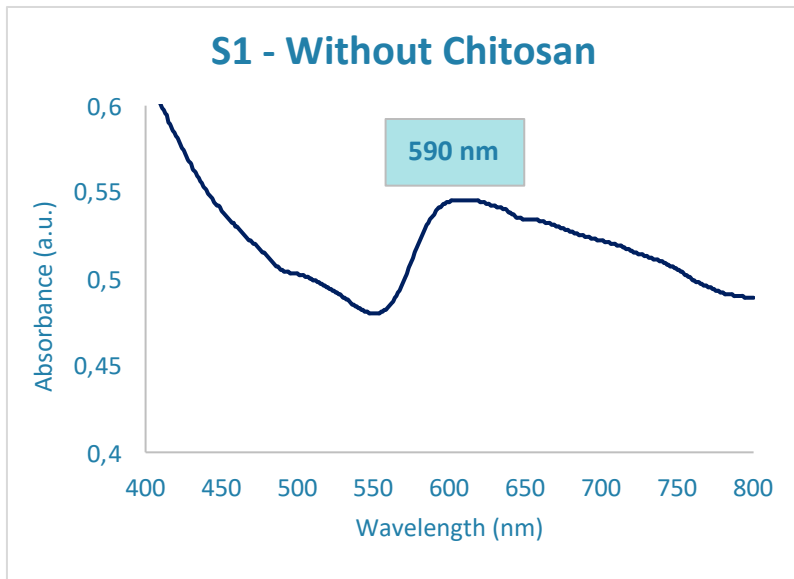
Objective

Provide antimicrobial properties to polyester fabric through an *in situ* method to synthesize CuNPs using cost-effective and safe chemicals in the presence and absence of chitosan



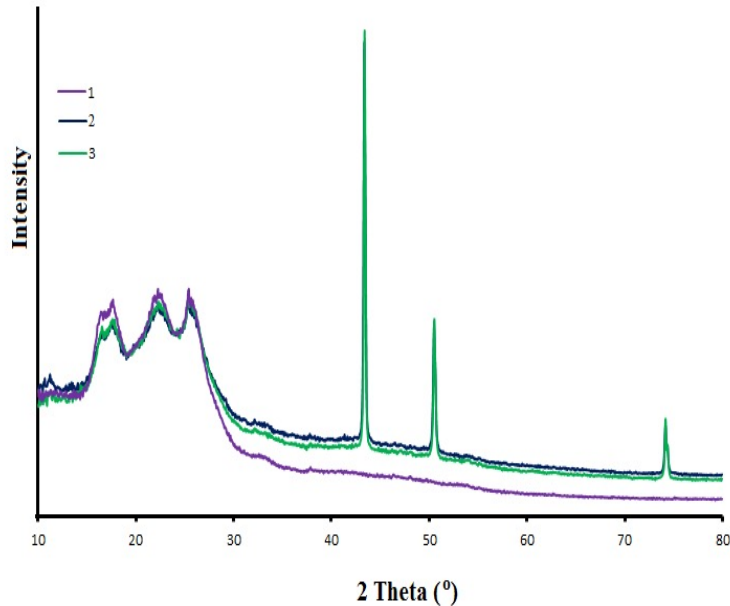
Characterization

UV-Vis



Characterization

XRD

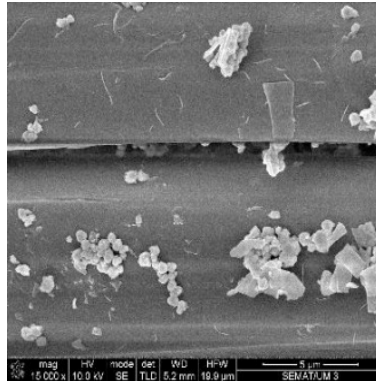
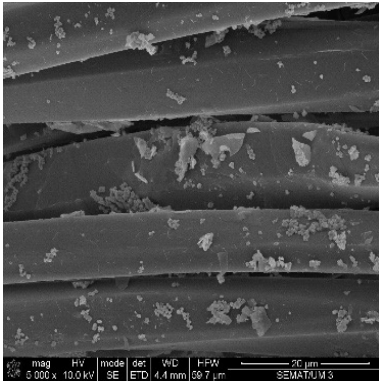


- For the **S1 - without Chitosan**, the characteristic peaks appeared at $2\theta = 43.354^\circ$, 50.479° and 74.152° are related to the plane index of (111) (200) (220), respectively.
- For the **S2 - with Chitosan**, the characteristic peaks appeared at $2\theta = 43.371^\circ$, 50.498° and 74.164° are related to the plane index of (111) (200) (220), respectively.
- The average crystal size of the CuNPs which were calculated by using the **Debar Scherrer relation** and was determined as **50.3 nm** and **56.0 nm** for S1 and S2, respectively.

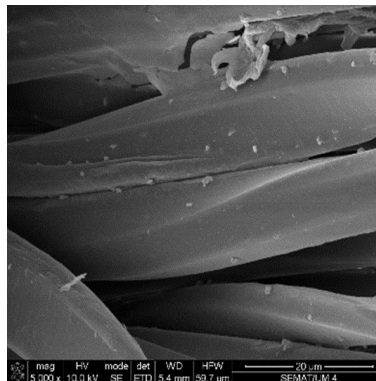
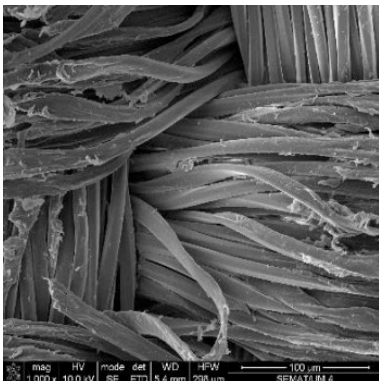
Characterization

SEM and EDS

S1 - Without chitosan

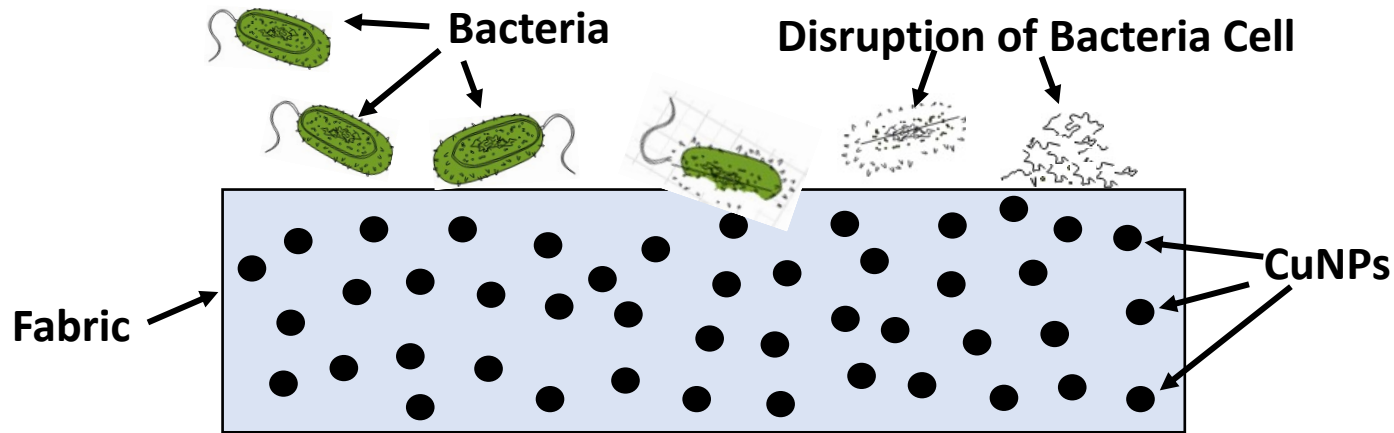


S2 - With Chitosan



Sample	Element	W%
S1 - Without Chitosan	C	66.77
	O	25.25
	Cu	7.71
S2 - With Chitosan	C	67.94
	O	30.34
	Cu	1.71

Antibacterial Tests



Antibacterial activity (percentage reduction) of the samples

Sample	S. aureus (%)	E. coli (%)	S. Aureus After 10 WC (%)	E. Coli After 10 WC (%)
Control	0	0	0	0
S1 Without Chitosan	99.9	99.9	99.9	99.9
S2 With Chitosan	99.9	99.9	99.9	99.9

Conclusion



- ✓ The synthesis and deposition of CuNPs on PES fabric using green chemicals were performed successfully;
- ✓ Both samples demonstrated suitable antibacterial properties against *Gram-positive* and *Gram-negative* bacteria opening new opportunities for the development of efficient and safe-by-design antimicrobial PES fabrics;
- ✓ The antimicrobial tests after 10 washing cycles showed a suitable durability of the functionalization.



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