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ABSTRACT

In this work, a new surface modification of the bamboo substrate with chitosan was studied, followed by subsequent treatment with gold nanoparticles (AuNP) by the exhaustion method, aiming at obtaining a technical textile with ultraviolet (UV) protection. The treatment with chitosan in the bamboo substrate induced an increase in the AuNP adsorption due to the electrostatic interactions between the chitosan amino groups and the citrate ion that surrounds the AuNP. The nanoparticles were obtained by the chemical reduction method, with some adaptations, using sodium citrate as a reducing agent/stabilizer and chlorouronic acid as precursor. The AuNP were characterized by transmission electron microscopy (TEM) and reflection, showing an average size of 35 nm. The presence of AuNP on the fiber surface was confirmed by SEM and XRD, with crystallographic peaks characteristic of gold. The UV protection factor was tested on the material, demonstrating excellent results.

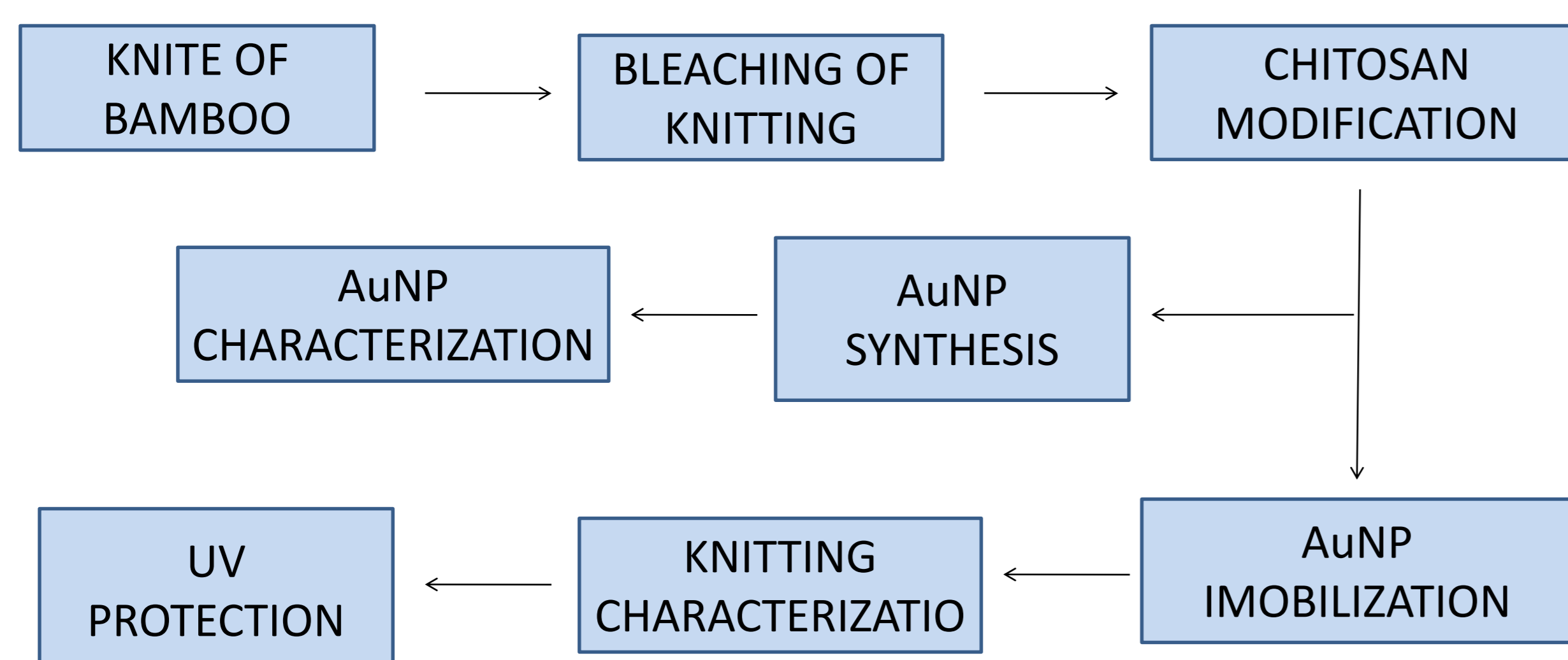
INTRODUCTION

Nanotechnology can provide high functional durability for textile materials due to nanoparticles have extremely large surface area to volume ratio and high surface energy, presenting higher affinity for fabrics, without affecting their breathability or hand feel properties^{1,2}. In the present work, we report a new material developed based on bamboo fibers, pre-treated with chitosan and functionalized with gold nanoparticles by the exhaustion method.

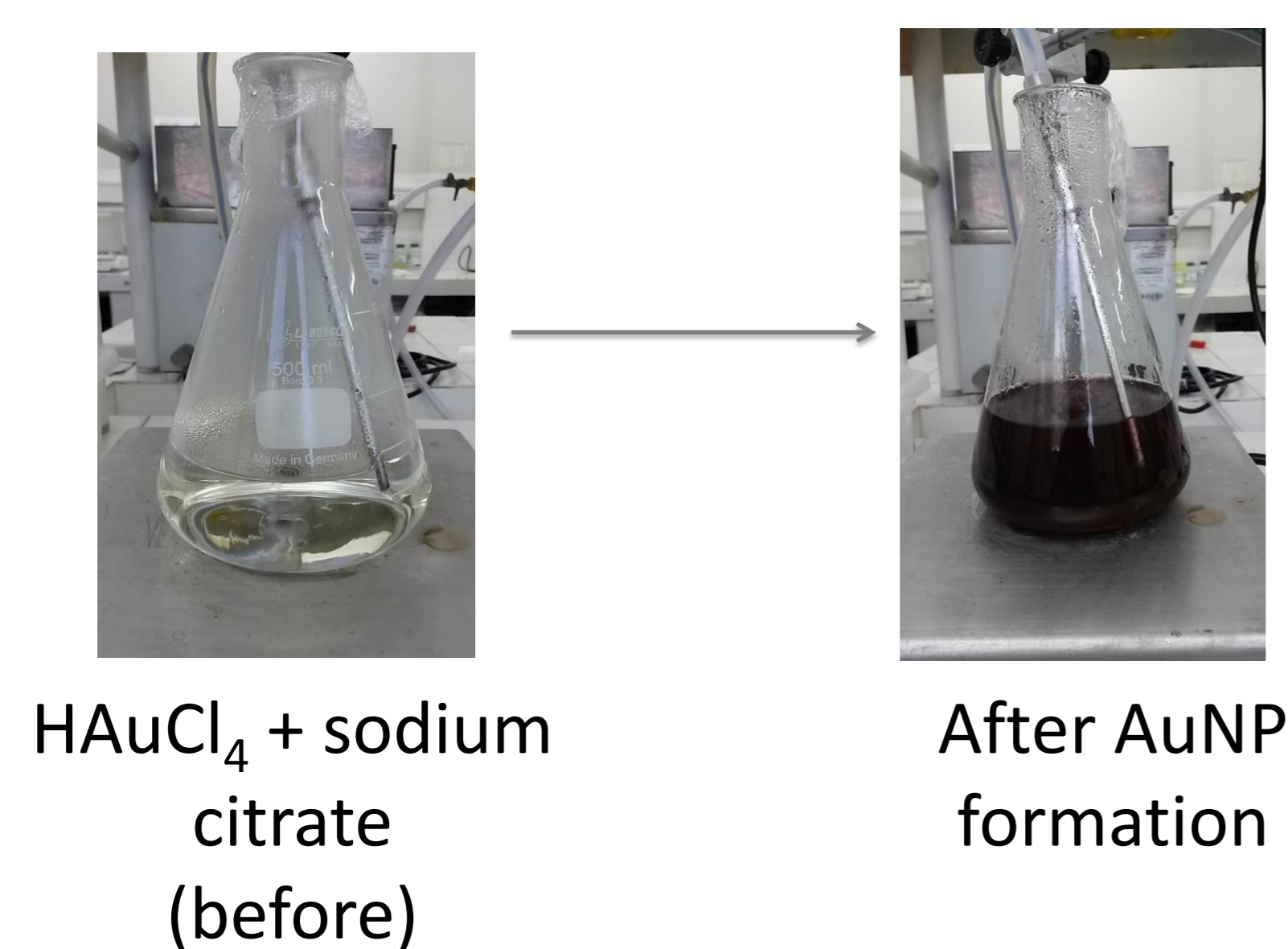
The UVA and UVB transmittance values of the AuNP functionalized bamboo fibers are excellent when compared to the untreated samples, which indicates that the treated substrate have a better blocking of UV radiation in the UVA and UVB regions. The ultraviolet protection factor (UPF) value of bamboo fabric with AuNPs is 101.7⁵. These results clearly show that bamboo fabric with Au nanoparticles can greatly improve UV protection properties, such as works in the literature that have shown gold nanoparticles in other polymeric systems have good UV-blocking properties⁶. The SEM (Fig. 1a) shows the NPs on the surface of the bamboo fabric, according to surface and the XRD (Fig. 2b) shows the characteristic peaks of the AuNPs, as evidenced by the crystallographic planes (111), (200), (220) and (311) that are characteristic of the crystalline gold system⁷.

EXPERIMENTAL METHODS

Experimental Development Route



AuNP SYNTHESIS



RESULTS AND DISCUSSION

The UV-vis spectrum of the synthesized AuNPs in sodium citrate (Fig. 1a) showed an absorption peak at about 540 nm due to surface Plasmon resonance band of the formed AuNPs. The Fig. 1b shows the TEM image of the synthesized AuNPs. This image demonstrated spherical shaped NPs in the range of 5–35 nm.

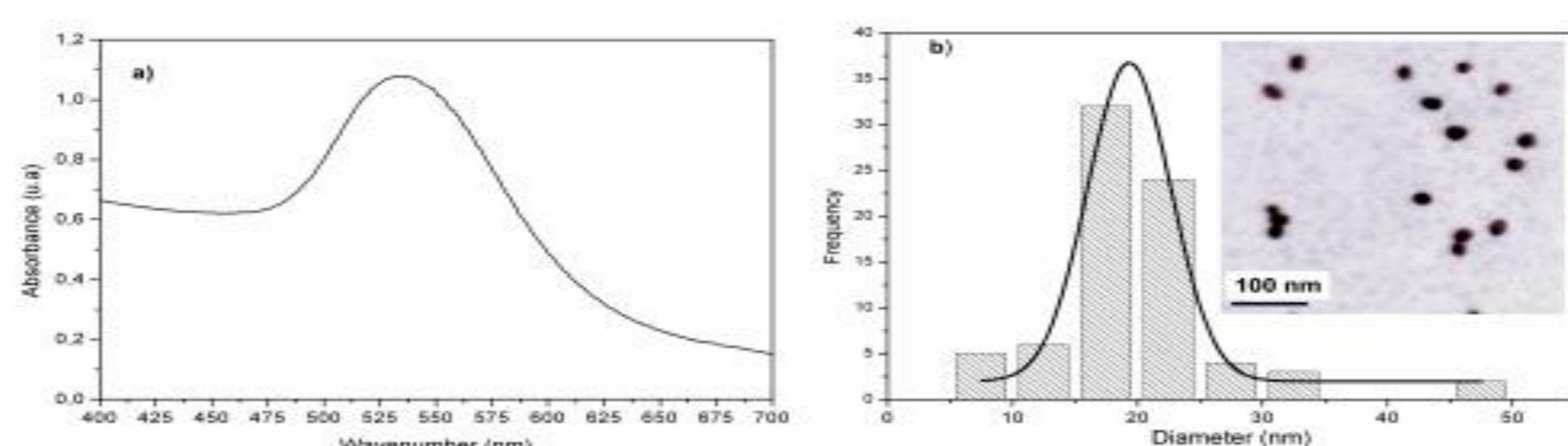


Figure 1. (a) UV-Vis spectra of a 0.25mM aqueous solution of HAuCl₄ with sodium citrate recorded as a function of the wavenumber. (b) TEM image of the synthesized AuNPs.

	Untreated	Treated
UVA Transmittance (%)	9,00	2,50
UVB Transmittance (%)	6,50	0,80
UPF	14,23 ± 1,64	101,70 ± 10,68
UVR protection category	Nil/Null	Excellent

Table 1. UV-blocking properties of the untreated and AuNP treated bamboo polymer

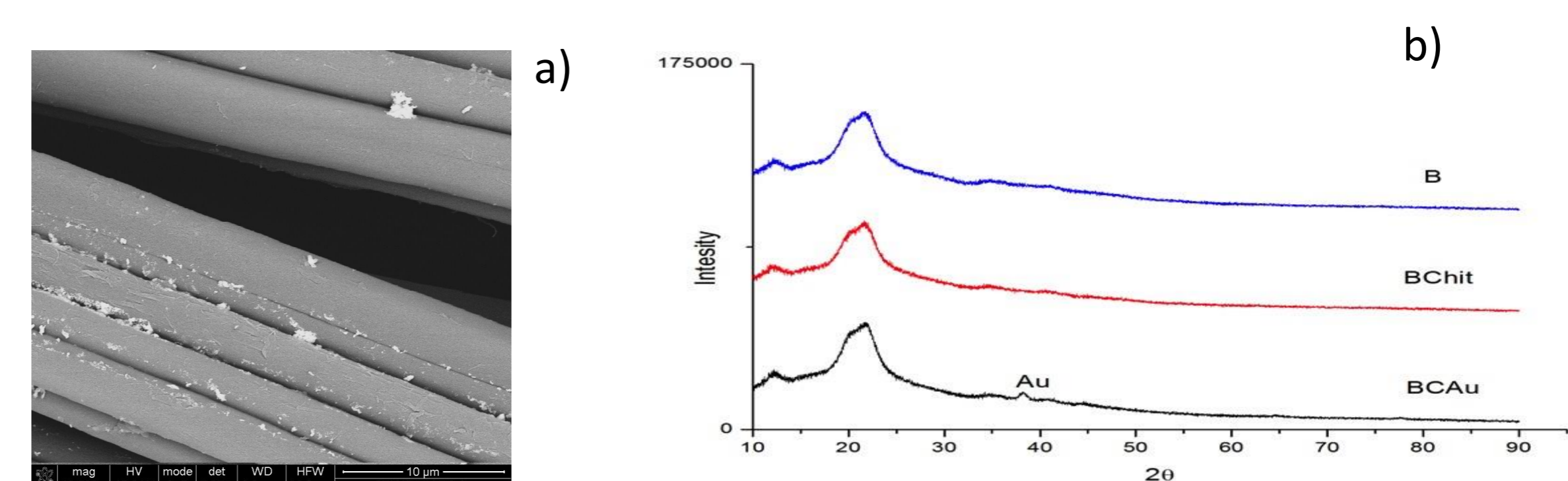


Figure 2. (a) SEM bamboo treated with AuNPs and (b) XRD samples untreated, treated with chitosan and treated with chitosan and AuNPs.

CONCLUSION

Reflectance spectrophotometry demonstrated the binding between chitosan and AuNPs and the characteristic peak of the colloidal solution at 540 nm. The characterization by SEM and XRD proved the existence of AuNP on the bamboo surface. The bamboo substrates treated with chitosan and gold nanoparticles showed a significant improvement in their ability to protect UV.

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