ASSESSMENT OF $Y_2SiO_5:Pr^{3+}$ COMPOUND TOXICITY ON *E. coli*

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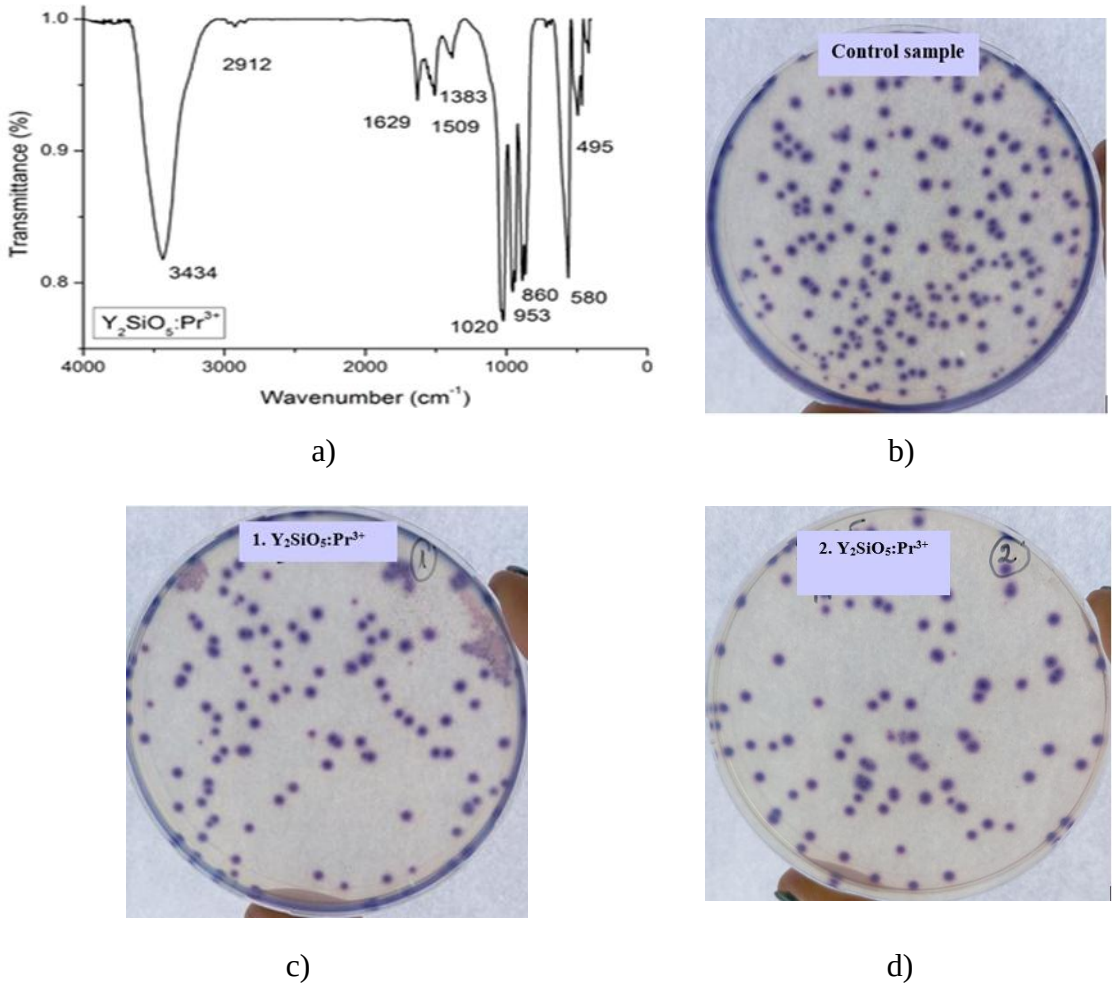
Abstract
In this study, the characterization of the $Y_2SiO_5:Pr^{3+}$ material and microbiological toxicity tests are presented. The sample was characterized by XRD [1], PL spectroscopy [1] and FT-IR. Microbiological assays having the purpose to evaluate the material toxicity effect on bacteria were conducted on *Escherichia coli* ATCC 8739.

Introduction
Ultraviolet light is a non-chemical disinfection method that employs extremely rapid physical light energy to eliminate microorganisms. UV radiation at 254 nm effectively destroys the DNA of microorganisms [1,2]. In the food industry [2], UV light is widely used for antimicrobial purposes, including the disinfection of water, air, food preparation surfaces, and containers. UV light leaves no residues, is not subjected to legal restrictions, and does not require extensive safety equipment. Given the rising prevalence of MRSA bacterial infections, there is a need to explore novel approaches for producing and maintaining aseptic surfaces. One way to produce UVC radiation is by utilizing UC materials that generate light in the germicidal spectrum [1,3]. These materials have the property of amplifying the energy of the photons emitted when illuminated with mono- and polychromatic light [4]. Spectroscopic studies for this type of material are generally conducted using laser radiation as the excitation source [5]. Therefore, the evaluation of the composite material's resistance to heating needs to be studied. This paper presents the FT-IR characterization of $Y_2SiO_5:Pr^{3+}$, and toxicity assays on the compound using the reference strain *E. coli* ATCC 8739.

Experimental
The Y_2SiO_5:(0.5-1.5) mol% Pr^{3+} sample was synthesized using a Pechini-type polymerized complex route. FT-IR spectra were obtained on a Vertex70 instrument from Bruker using KBr pellets. Specific culture medium for E. coli and coliform bacteria, Chromocult® Coliform Agar, prepared as per the manufacturer's instructions, was used. The experiments were conducted using the reference strain E. coli ATCC 8739, with a concentration of 5.8 x 10^3 CFU per pellet. The strain was hydrated for one hour in 10 ml of peptone water prior to testing. E. coli bacterial suspension and a mixture of $Y_2SiO_5:Pr^{3+}$ and bacteria was inoculated on Petri dishes and incubated for 24 hours at 37°C. The microbiological experiments were performed in duplicate.

Results and discussion
The XRD and photoluminescence characterization was presented in our previous work [1].
The FTIR spectrum, figure 1 a, shows the lower peaks positioned at about 455 cm^{-1} corresponding to Si–O bending modes. The peak at 580 cm^{-1} have been assigned to Si–O

symmetric stretching mode. The band at 1509 cm^{-1} and 1629 cm^{-1} could be attributed to Pr–O vibrations. The bands at 860–1020 cm^{-1} confirm the presence of the SiO_4 group. The broad band with a maximum at 3434 cm^{-1} is due to the adsorption of water on the oxide material. Several other unidentified peaks can be observed in the spectrum.



a) b)

c) d)

Figure 1. a) FTIR spectrum of Y_2SiO_5:Pr3+ compound and images of plates inoculated with *E. coli* (purple being the specific color of these colonies on Chromocult medium): b) control; c) mixed with Y2SiO5:Pr3+; d) duplication of previous.

Microbiological assays were carried out using the reference strain *E. coli* ATCC 8739 and Chromocult® Coliform Agar, streaking was conducted using the flooding technique with 0.6 ml of the aqueous solution on plates. After the incubation period (24 hours), macroscopic cultures are observed to determine the growth rate as shown in figure 1 b, c, d, the control sample exhibited a larger number of CFU compared with the sample mixed with our compound. The control sample, after counting had a total number of 219 CFU, while the first and second sample, both containing the bacterial solution and 6 mg of $Y_2SiO_5:Pr^{3+}$ each, had a 53% decrease in the number of CFU. In the plate culture method, there may be toxicity upon contact with the substance, which is present at a relatively high concentration. Although, in the plate culture method, colony growth is limited by direct contact with the solid on the surface of the culture medium, the toxicity of our compound was clearly detected. This demonstrates the possibility of obtaining surfaces with germicidal effects upon contact, even in the absence of excitation with visible light.

Conclusion

$Y_2SiO_5:Pr^{3+}$ compound synthesis was successful, exhibiting UVC light emission [1] under visible light excitation. $Y_2SiO_5:Pr^{3+}$ exhibited a noticeable bacterial growth inhibition upon *E. coli* ATCC 8739.

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