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BIOACTIVE SOL–GEL COATINGS OBTAINED BY NETWORK EMBEDDING OF PHYTOSYNTHESIZED SELENIUM NANOPARTICLES

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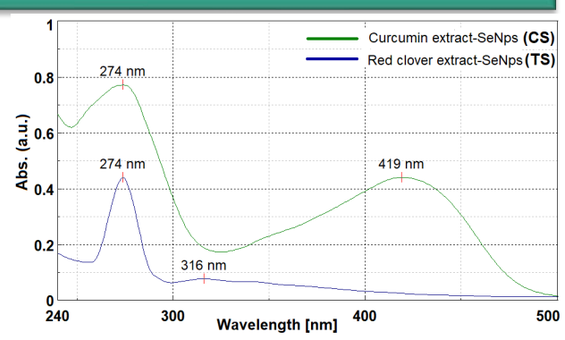
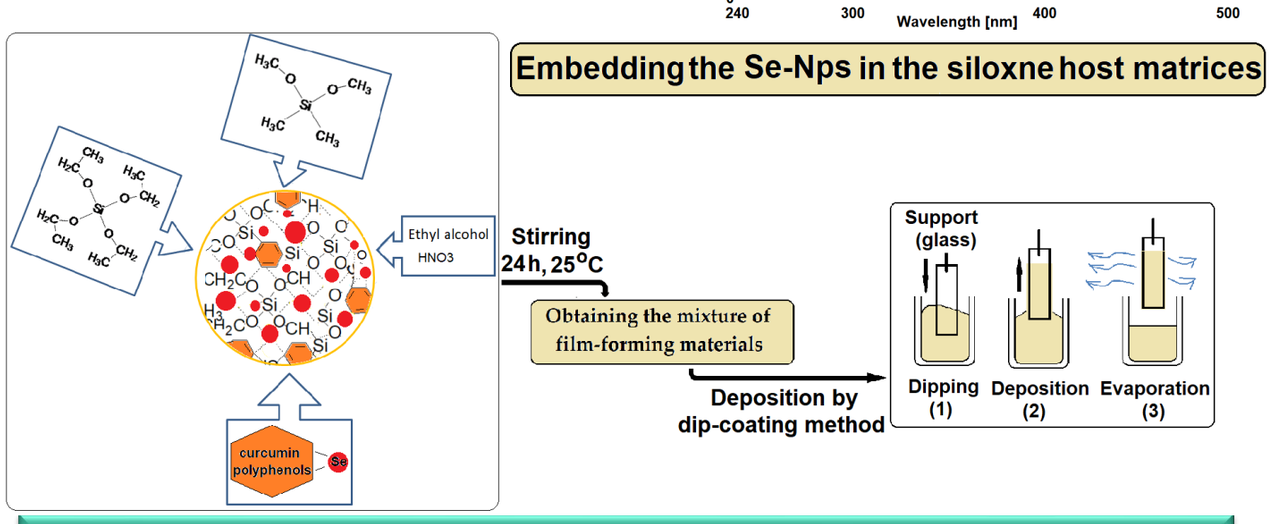
INTRODUCTION & AIM

Nanotechnology plays a crucial role in the advancement of functional materials, particularly in biomedical, food, and surface protection applications. Among the metallic nanoparticles investigated, selenium nanoparticles (SeNPs) are notable due to their antioxidant, antibacterial, and anticancer activities. Phytosynthesis offers an environmentally friendly and cost-effective approach to obtain SeNPs, employing plant extracts as both reducing and stabilizing agents. However, their efficient use requires stabilization and controlled release, for which encapsulation in sol-gel matrices has proven to be a versatile and effective strategy [1–3].

METHOD

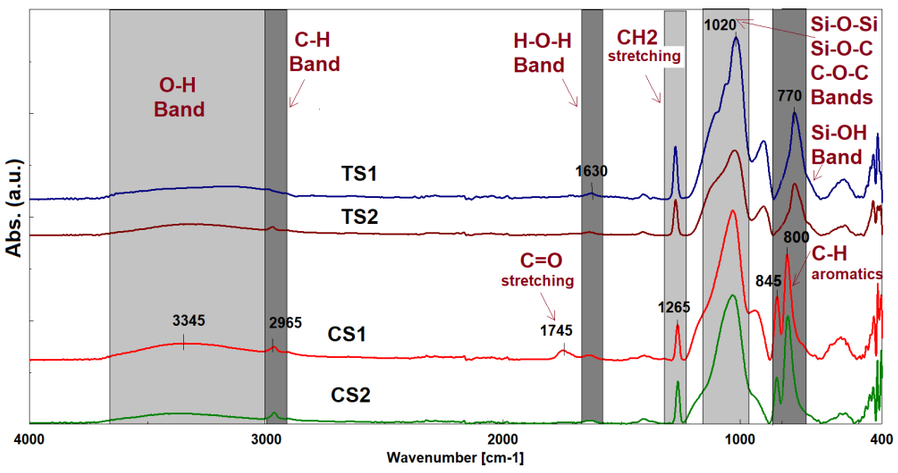
Sample	CS/TS [mL]	TEOS [ml]	DMDMS [ml]
CS1	1.6	2.4	0.4
CS2	3.2	2.4	0.8
TS1	1.6	1.6	0.4
TS2	3.2	1.6	0.8



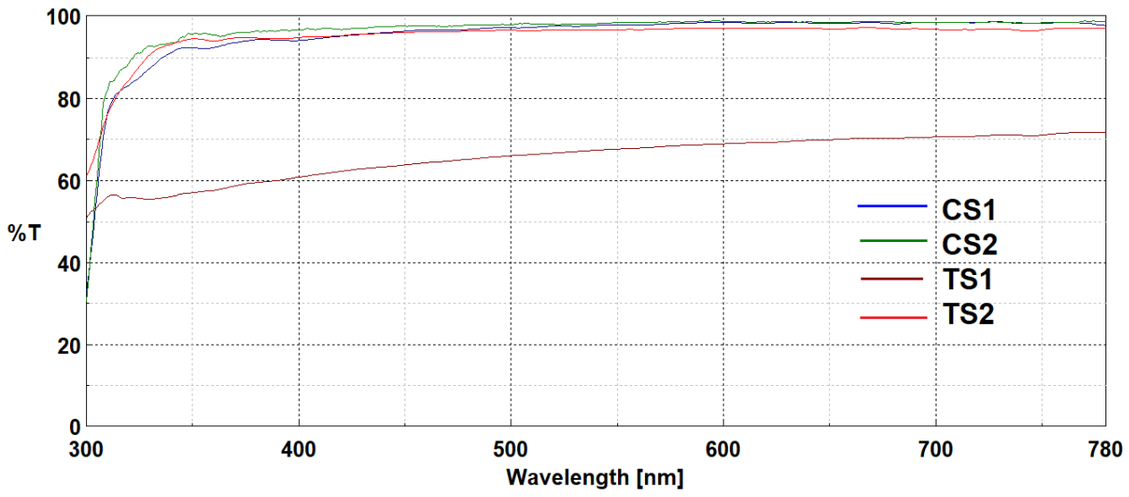


Embedding the Se-Nps in the siloxne host matrices

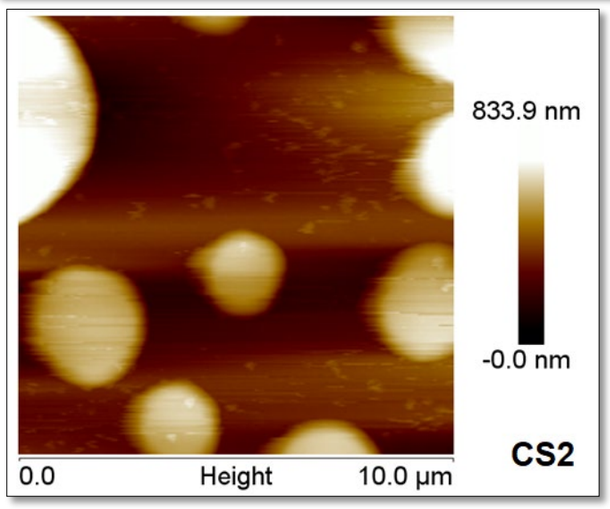
RESULTS & DISCUSSION



The silane matrix increased the transmittance of the glass support, with the coatings being compatible with the hydrophilic surface of the glass through intermolecular hydrogen bonds.

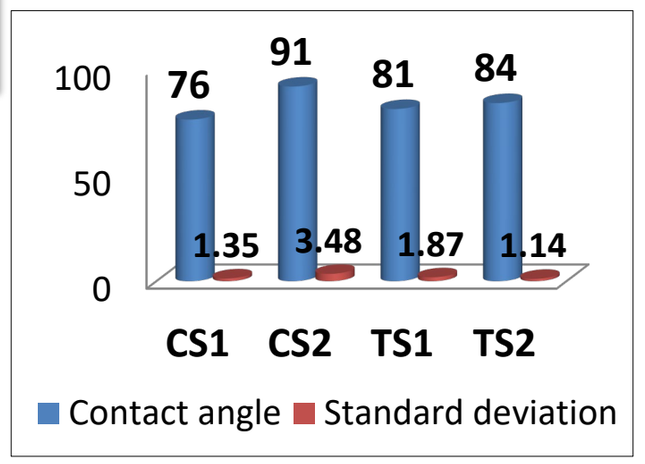


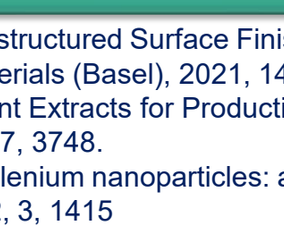
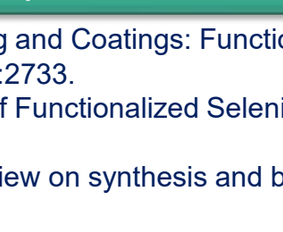
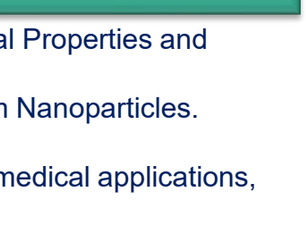
SEM images confirm the generation of SeNps (A) and are supported by EDX analysis (B).
The embedding of polyphenol-SeNps nanocomposites in silica host networks is observed in (C) and (D).



The topography of the silane coatings decorated with SeNps is observed by AFM analysis. This highlights the important role of the host matrix and its influence on the antimicrobial activity of selenium.

The coatings contain nanocomposites in different concentrations and, depending on the ratio of the siloxane precursors lead to contact angles situated between 76-91 degrees.



	Staphylococcus aureus	*Escherichia coli*	*Candida albicans*
Sample / Diameter of the zone of inhibition (mm)			
TS1	-	12	-
CS1	12	15	13
TS2	17	21	13
CS2	23	25	30

CONCLUSION

The results suggest strong potential for these SeNP-based sol-gel materials in biomedical and protective applications such as wound dressings, antioxidant/UV protection films, and antibacterial textiles.

FUTURE WORK / REFERENCES

1. Ielo I at all. Nanostructured Surface Finishing and Coatings: Functional Properties and Applications. Materials (Basel), 2021, 14(11):2733.
2. Pyrzynska, K. Plant Extracts for Production of Functionalized Selenium Nanoparticles. Materials 2024, 17, 3748.
3. Bisht, N. at all. Selenium nanoparticles: a review on synthesis and biomedical applications, Mater. Adv., 2022, 3, 1415

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