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

Monica Florentina Raduly, Valentin Raditoiu, Alina Raditoiu, Adriana Frone, Iuliana Raut

National Institute for Research & Development in Chemistry and Petrochemistry—ICECHIM, 202 Splaiul Independentei, 060021 Bucharest, Romania

monica.raduly@icechim.ro

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].

This work presents the synthesis and characterization of bioactive sol-gel coatings functionalized with selenium nanoparticles (SeNPs) obtained via phytosynthesis. SeNPs were generated using *Trifolium pretense* or *Curcuma longa* plant extracts, which act as reducing and stabilizing agents, converting Se^{4+} ions from Na_2SeO_3 into elemental selenium (Se^0). The nanoparticles were incorporated into hybrid sol-gel matrices generated from tetraethyl orthosilicate (TEOS) and dimethoxydimethylsilane (DMDMS) in various ratios (TEOS:DMDMS = 2:0.5–2, v/v). Hydrolysis and condensation of the precursors were catalyzed by 0.1 M HNO_3 at 25 °C for 24 h. The resulting sols were deposited onto glass substrates by dip-coating and thermally treated to consolidate the network and immobilize the SeNPs. Surface morphology was investigated by atomic force microscopy (AFM) and scanning electron microscopy (SEM), chemical structure by Fourier-transform infrared (FTIR) spectroscopy, optical properties by UV-Vis. Antimicrobial tests against *S. aureus*, *E. coli*, and *C. albicans* confirmed the biological activity of the coatings. 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.

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