Materials Chemistry and Physics 296 (2023) 127245

Contents lists available at ScienceDirect

Materials Chemistry and Physics

journal homepage: www.elsevier.com/locate/matchemphys

Microstructural, electrical and mechanical characterizations of green-synthesized biocompatible calcium phosphate nanocomposites with morphological hierarchy

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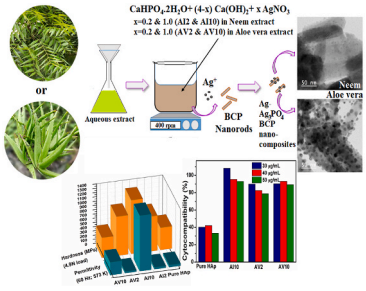
HIGHLIGHTS

- $Ag–Ag_3PO_4$-BCP nanocomposites hydrothermally synthesized in neem and aloe vera media.
- Epitaxial attachments of metallic phases to mesoporous uniaxial BCP nanorods.
- Biocompatibility and stability up to high dosage for 72 h studied on healthy cells.
- High interfacial polarization and surface charge retention ability for osteoconduction.
- Bulk porosity and unique structure-dependent dielectric and mechanical properties.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Nanocomposites
Electron microscopy
Porosity
Dielectric properties
Impedance
Mechanical properties

ABSTRACT

The present work reports the development of novel ternary silver-silver phosphate-biphasic calcium phosphate nanocomposites by plant-extract mediated hydrothermal route. Unique epitaxial morphological growth of the $Ag–Ag_3PO_4$ core-shell structure influences the internal grain-grain boundary arrangement. The green-assisted development of the constituent phases helps significant biocompatibility enhancement (~89–93% for 50 μg/mL; 72 h). Hence long-term bone-replacement purposes and polar fluid osmosis are favorable due to higher cell attachment on the rough surface of the mesoporous nanocomposites. The heterogeneous attachment between the three phases creates defect states indicating intense interfacial polarization, as elucidated by the dielectric spectroscopic studies. The surface charge essential for bone regeneration is likely to be developed. Besides, the porous nanocomposite compacts exhibit superior phase-composition-dependent mechanical (Hardness ~1.3 GPa; load 4.9 N) and dielectric properties (permittivity ~1.2×10^3; 200 Hz, 613 K) helping in conduction through bones. Thus the green-synthesized ternary nanocomposites exhibit the essential aspects of a promising bone-implant material.

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https://doi.org/10.1016/j.matchemphys.2022.127245
Received 24 September 2022; Received in revised form 11 December 2022; Accepted 19 December 2022
Available online 27 December 2022