

MAPLE ANTIMICROBIAL COATINGS BASED ON LOW-COST SUSTAINABLE NATURAL RESOURCES

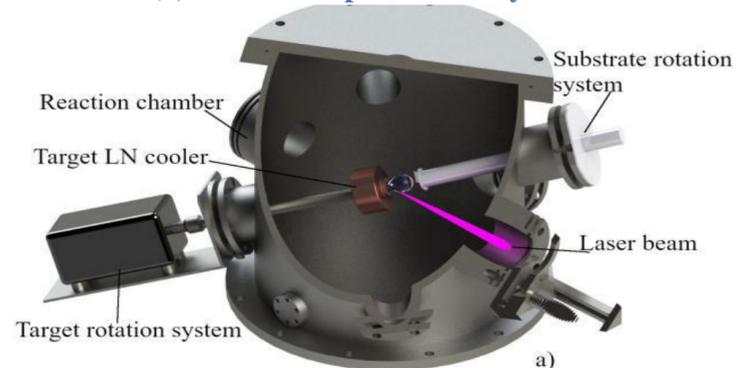
Anita Ioana Visan ^{1,*}, Carmen Ristoscu ¹, Gianina Popescu-Pelin ¹, Mariana Carmen Chifiriuc ^{2,3}, Marcela Popa ², George Stan ⁴, T Tite ⁴, and Ion N. Mihailescu ¹¹ National Institute for Laser, Plasma and Radiation Physics, 077125 Magurele, Ilfov, Romania; ² Department of Microbiology, Faculty of Biology, University of Bucharest, 060101 Bucharest, Romania; ³ Earth, Environmental and Life Sciences Division, Research Institute of the University of Bucharest, 050567 Bucharest, Romania; ⁴ National Institute of Materials Physics, 077125 Magurele, Ilfov, Romania;Corresponding author: anita.visan@infllpr.ro

MOTIVATION AND AIMS

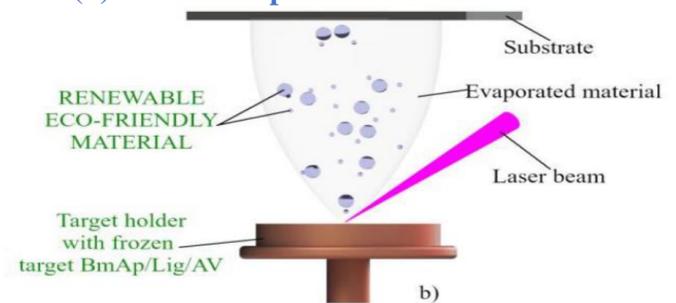
This project aims for obtaining functionalized implants covered with **innovative apatite-lignin-aloe vera (HA/Lig/AV) coatings** fabricated by **Matrix Assisted Pulsed Laser Evaporation (MAPLE)**. The use of **NATURAL AND RENEWABLE PRODUCTS (Lignin and Aloe Vera plant extract)** for infections prevention is a **green alternative** for synthetic currently-used antibiotics, since the concerning phenomenon of primary and secondary resistance to conventional drugs became an alarming life-threatening circumstance. The use of these natural-derived products involves reduced costs and represents an attractive solution for the fabrication of biodegradable thin films with antibacterial, antioxidant and anti-inflammatory potential.

EXPERIMENTAL CONDITIONS AND SETUP

(a) MAPLE experimental system



(b) MAPLE deposition scheme.



KrF* laser source

$\lambda = 248 \text{ nm}$, $\tau_{\text{FWHM}} \leq 25 \text{ ns}$,
laser fluency : 350 mJ/cm^2
Vacuum 10^{-2} mbar

SAMPLE CODE

HA-Lig

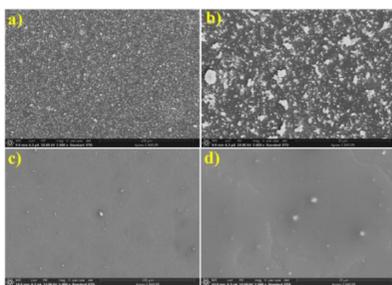
HA-Lig-AV-recipe 1

HA-Lig-AV-recipe 2

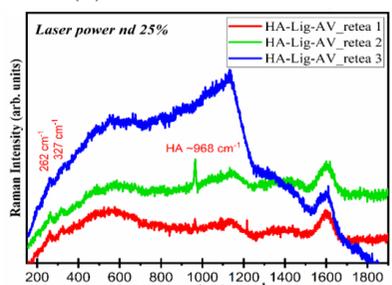
OBSERVATIONS

((HA-Lig), $c = 5\%$ in DMSO)((HA-Lig-AV-recipe 1; Lig: AV -1: 3), $c = 5\%$ in DMSO)((HA-Lig-AV-recipe 2; Lig: AV -2: 2), $c = 5\%$ in DMSO)

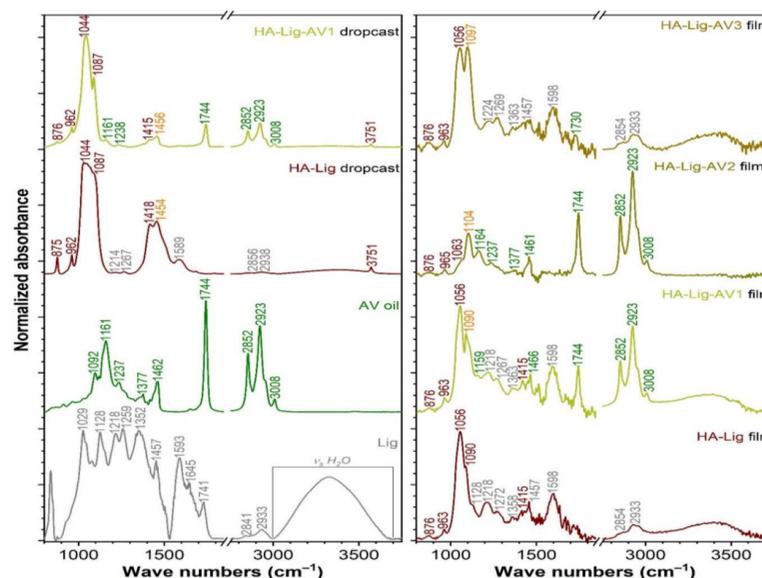
RESULTS AND DISCUSSIONS



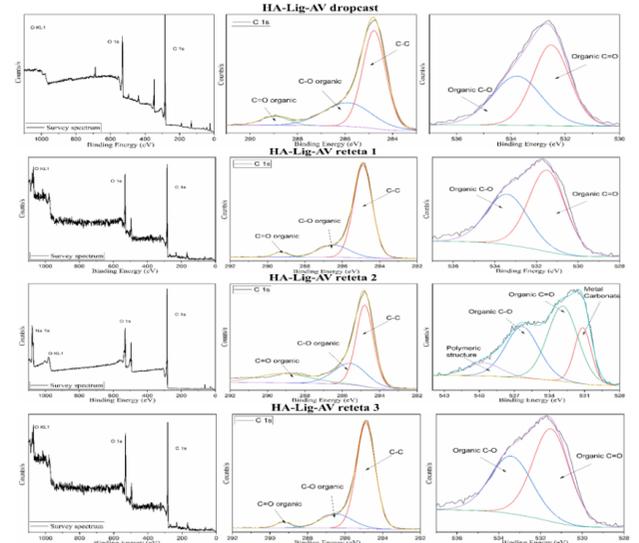
Typical SEM micrographs of HA-Lig thin films - 1000x magnification of (a); HA-Lig magnification 5000x (b); HA-Lig-AV - magnification 1000x (c) and HA-Lig-AV - magnification 5000x (d).



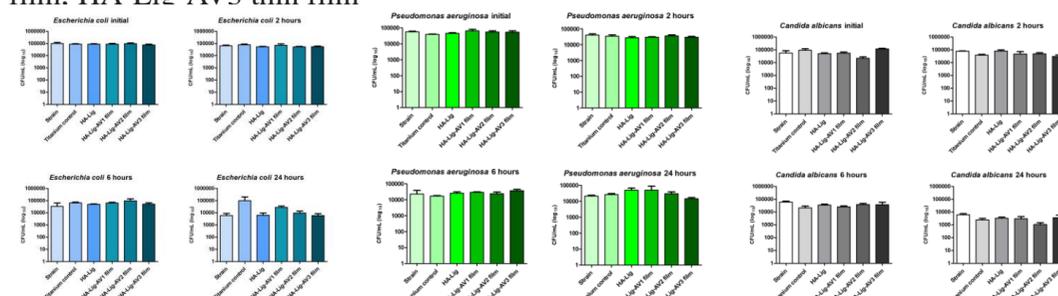
Raman spectra recorded on HA-Lig-AV :recipe 1; recipe 2 and recipe 3 synthesized by the MAPLE in the spectral region corresponding to the bands (1800-200) cm^{-1}



FTIR spectra of the investigated materials: Lignin powder; Aloe Vera essential oil, HA-Lig (dropcast and thin film); composite films: HA-Lig-AV1 (dropcast and thin film); HA-Lig-AV2 thin film; HA-Lig-AV3 thin film



High-resolution XPS spectra of HA-Lig thin films; HA-Lig-AV-dropcast; HA-Lig-AV: recipe 1; recipe 2; recipe3.



Evaluation of the dynamics of:

- *E. coli*;
- *P. aeruginosa*
- *C. albicans* viability in the presence of tested materials.

CONCLUSIONS AND PERSPECTIVES

- ❖ Apatite-lignin-aloe vera (HA-Lig-AV) thin films were synthesized by a MAPLE.
- ❖ When the amount of essential oil is equal to that of organic material(HA-Lig-AV2): a fine, uniform and relatively homogeneous distribution of the deposited material was obtained. The presence of organic materials and the integrity of the chemical functions and the stoichiometry of the unaltered deposited material was demonstrated.
- ❖ HA-Lig-AV3 film, after 24 hours, inhibits microbial growth after 24 hours of Gram-negative bacteria.
- ❖ HA-Lig-AV2 film, after 24 hours, inhibits the development of Gram-positive bacteria (*E. coli* and *E. faecalis*) and *C. albicans* strain.
- ❖ We identify the **optimal material recipe** (namely: HA-Lig-AV2; Lig: AV ratio -2: 2)!!

Acknowledgements:

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