

Supporting information

Fabrication of Antibacterial Silver Nanoparticle – Sodium Alginate-Chitosan Composite Films

Shilpa Sharma,^a Pallab Sanpui,^a Arun Chattopadhyay^{*a b} and Siddhartha Sankar Ghosh^{*a c}

^aCentre for Nanotechnology, ^bDepartment of Biotechnology and ^cDepartment of Chemistry, Indian Institute of Technology Guwahati, Guwahati-39, Assam, (India)

*Corresponding author: Email: sghosh@iitg.ernet.in, arun@iitg.ernet.in

MATERIALS AND METHODS

Chemicals and Growth media

Chitosan (high MW, >75% deacetylated) was obtained from Sigma Aldrich Chemical Pvt. Ltd., Kolkata, India and alginate from Loba Chemie Pvt. Ltd., Mumbai, India. Silver nitrate, acetic acid (glacial, 99–100%) and acetone were purchased from Merck India Ltd, Mumbai, India. Luria-Bertani Broth (LB), Nutrient broth (NB) and brain-heart infusion (BHI) growth media were purchased from HiMedia, Mumbai, India. For preparing solid media, the nutrient media was supplemented with 1.5 % bacteriological agar (HiMedia Laboratories Ltd., Mumbai) as solidifying agent.

Bactericidal activity of the composite

The antibacterial activity of Alg-Ag NPs was tested against *E. coli* and *B. cereus* MTCC 1305 as representative strains of Gram negative and Gram positive bacteria respectively by well diffusion method. The suspensions of bacterial cultures in the range of 10^5 - 10^6 cfu ml⁻¹ were made and streaked over the surface of agar plates to obtain uniform growth. After the plates were dried for

5 min, 4 distinct wells were punctured into the agar plates and filled with Alg-Ag NPs solution and alginate solution as control. The zones of inhibition were observed after incubation at 37°C overnight.

RESULTS

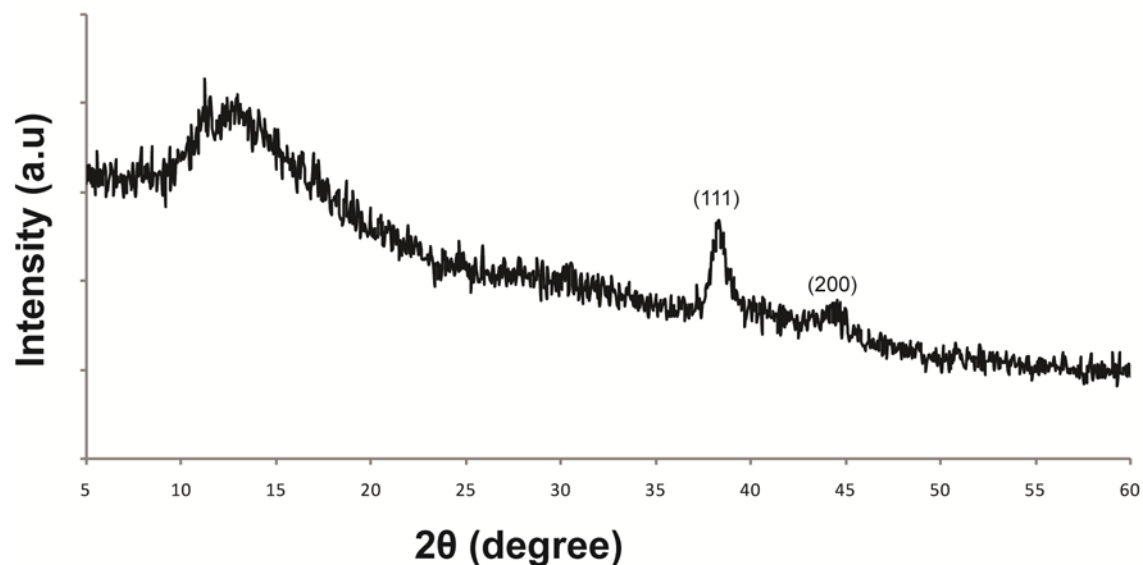


Figure S1. XRD pattern of Alg-Ag NPs showed peaks at 38.2° and 44.3° corresponding to the (111) and (200) planes of the cubic structure of metallic Ag. Absence of peaks at 32.8°, 46.2° and 54.6° corresponding to Ag₂O¹⁻² indicates that Ag₂O does not form during the synthesis.

Ag NPs were prepared at higher Ag NO₃ concentrations (2×10^{-3} M and 4×10^{-3} M) keeping alginate concentration and temperature as 0.2 % and 90 °C, respectively. UV-Vis spectra measurements (Figure S2) showed broad peaks at ~409 nm and ~413 nm for NPs prepared using 2×10^{-3} M and 4×10^{-3} M Ag NO₃ concentration, respectively indicating wide distribution of NPs. This was confirmed by TEM measurements. For NPs prepared using 2×10^{-3} M Ag NO₃ concentration, particles of various shapes were formed (Figure S3a). The particle size distribution was calculated by measuring diameters of spherical particles. The average size was calculated to be 5.65 ± 2.4 nm (Figure S3c). In case of NPs synthesized using 4×10^{-3} M Ag

NO_3 , TEM images showed that the particles of various irregular morphologies were formed (Figure S3b). Most of the particles were found to be aggregated.

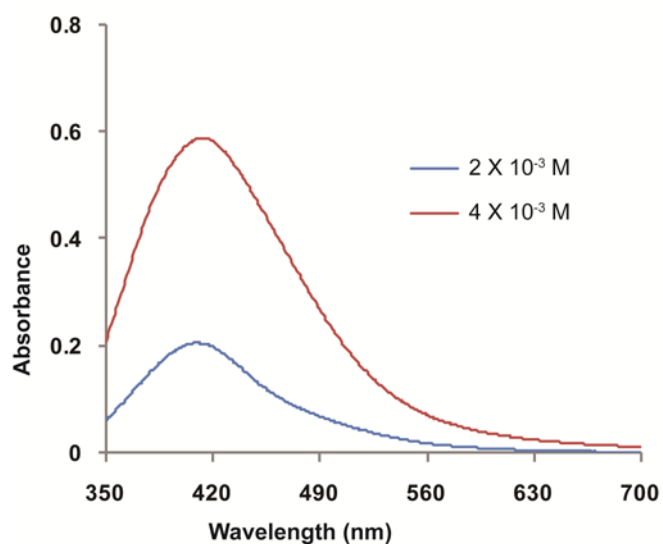


Figure S2. UV-vis spectra of Ag NPs prepared using 5 times and 10 times initial Ag NO_3 concentrations (i.e. 2×10^{-3} M and 4×10^{-3} M respectively) and 0.2 % alginate at 90 °C.

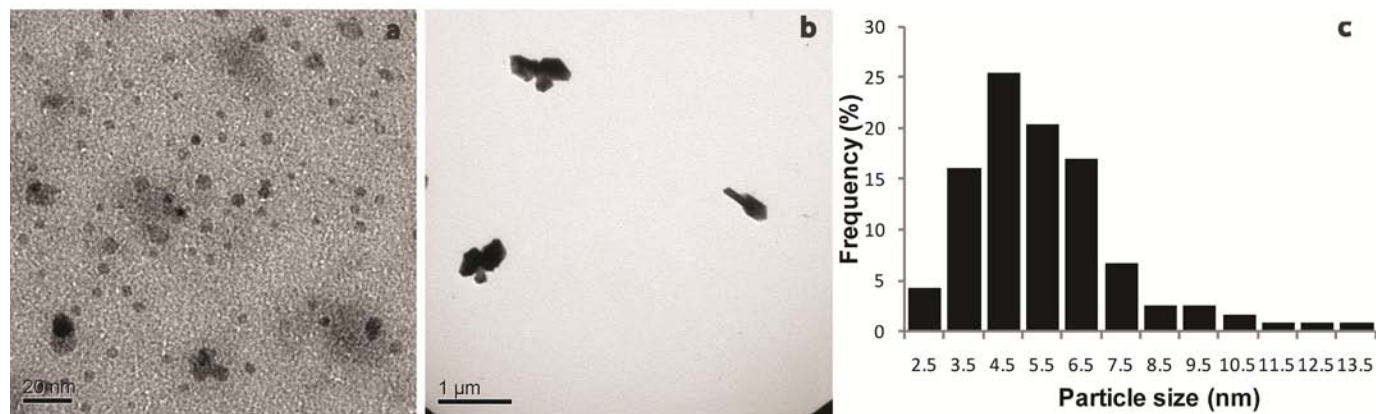


Figure S3. TEM images of NPs synthesized using (a) 2×10^{-3} M and (b) 4×10^{-3} M of Ag NO_3 , (c) Particle size distribution of NPs prepared using 2×10^{-3} M Ag NO_3 .

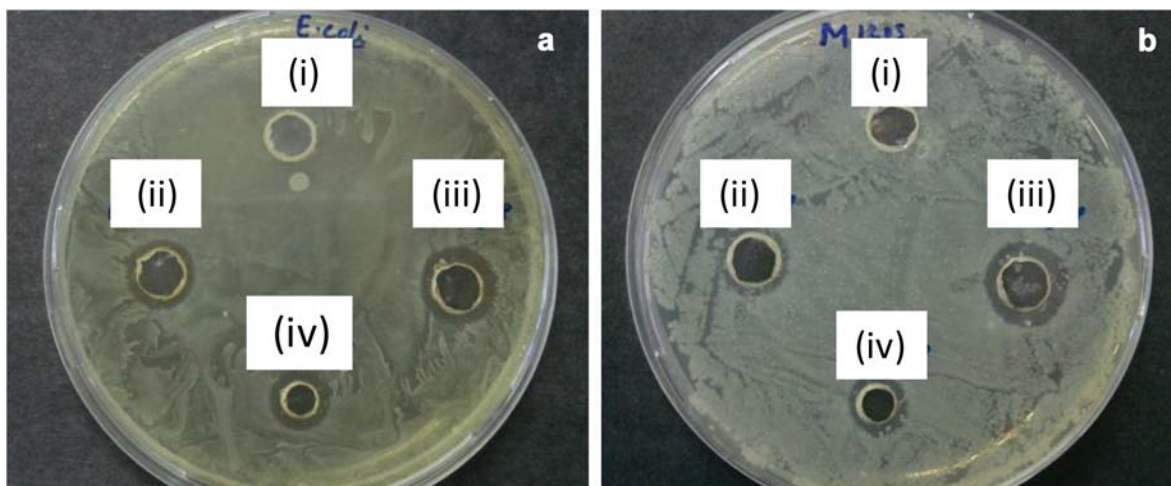


Figure S4. Photographs of antimicrobial test results of (i) alginate and (ii-iv) Alg-Ag NPs against (a) *E. coli* and (b) *B. cereus* MTCC 1305 strains.



Figure S5. Photograph of different (C) chitosan, (1) 1:1, (2) 2:1 and (3) 4:1 films

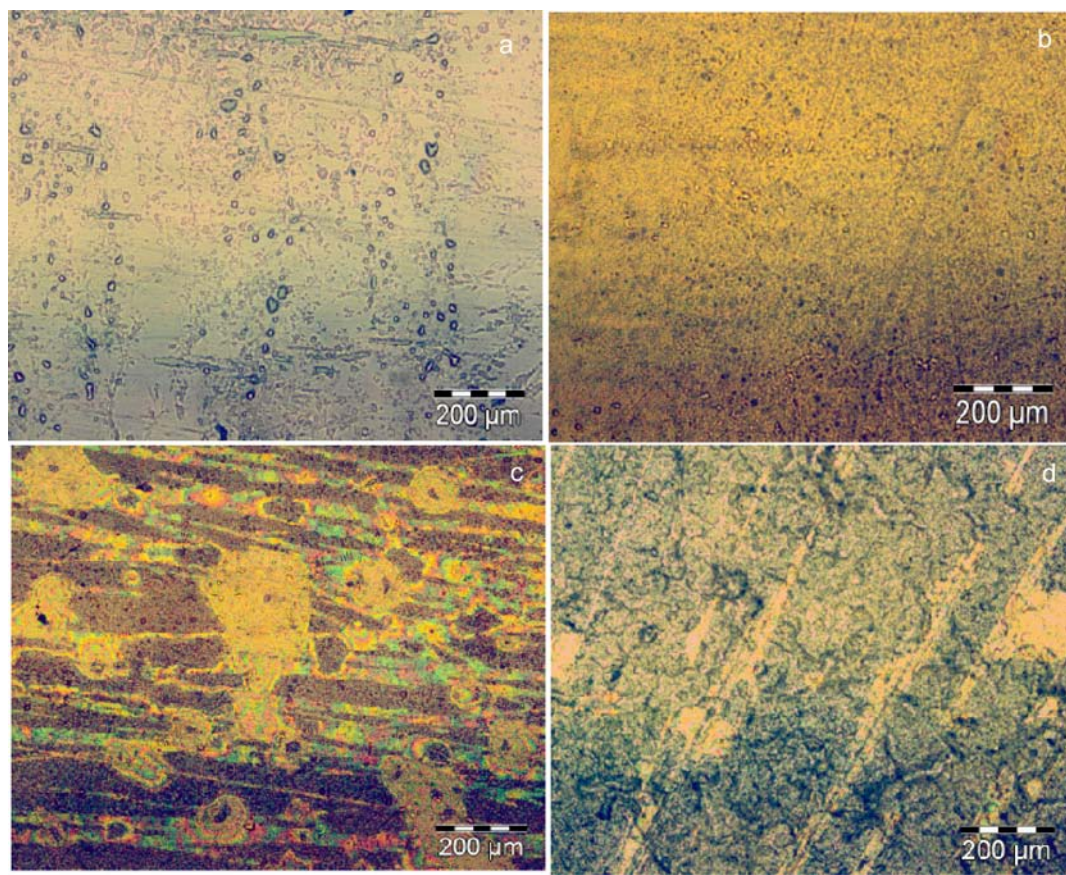


Figure S6. Optical micrographs of (a) chitosan film (b) 1:1, (c) 2:1 and (d) 4:1 blended films.

REFERENCES

1. S. Pal and G. De, *Materials Research Bulletin*, 2009, **44**, 355-359.
2. Y. Xiao, Y.S. Li and G. H. Swihart, *Talanta*, 2002, **58**, 755-760.