

# **Wettability, morphological, miscibility characterization of alginate, and chitosan-based bio composite coatings**

## **Abstract**

This study is aimed at fabricating composite biocompatible coatings of Alginate (Alg) and Chitosan (CS) on a stainless steel (grade 316L) substrate, reinforced with several percent nanoparticle additives, Using a dip coating method. The research used Fourier Transform Infrared (FTIR), field emission scanning electron microscopy (FESEM), and Atomic force microscopy (AFM) to explore surface roughness, size dispersion, and surface topography. The introduction of nanoparticles enhanced the wettability of the CS/Alg coatings. Notably, nanoparticle coatings with TiO<sub>2</sub>, Nb<sub>2</sub>O<sub>5</sub>, and biotin showed exceptional wettability due to the hydrophilic qualities of the matrix and reinforcements. This was corroborated by contact angle measurements, which confirmed the hydrophilic nature of the chitosan-alginate blend. The FTIR results highlighted the noticeable compatibility between CS-Alg and (TiO<sub>2</sub>, Nb<sub>2</sub>O<sub>5</sub>, and biotin) nanoparticles. No discernible alterations in the wavelengths were observed. Employing biotin-TiO<sub>2</sub>-Nb<sub>2</sub>O<sub>5</sub>, the FESEM showed that the biocompatible coating films were uniform and devoid of cracks on the 316L stainless steel substrate. The matrix + TiO<sub>2</sub>, matrix + Nb<sub>2</sub>O<sub>5</sub>, matrix + TiO<sub>2</sub> + Nb<sub>2</sub>O<sub>5</sub>, and matrix + TiO<sub>2</sub> + Nb<sub>2</sub>O<sub>5</sub> + biotin-coated 316L stainless steel showed roughness data of 4.14, 5.28, 7.04, and 8.02 nm, accordingly, in contrast with the neat chitosan/alginate coating, which displays 2.67 nm, suggesting the significant impact of biotin and oxides on surface topography. These findings underscore the potential of the developed nanoparticle coatings for orthopedic applications, with enhanced wettability and biocompatibility. Biocompatible coatings emerging from this research are promising for advancing orthopedic and biomedical devices as they are used in scientific studies because of their biocompatibility with human tissues.

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