# Electrophoretically Deposited Bioceramic Composite Coatings on Ti Substrate Intended for Medical Use

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Bone implant materials are increasingly attracting attention in the biomaterials field. Among them, hydroxyapatite (HAP) has stood out as a prospective biomaterial due to excellent osseointegration ability, owing to its similarity with natural bone. However, due to the lack of adhesive and antibacterial properties, it is usually combined with polymers and antibacterial agents. Natural polymer chitosan (CS) was proven as an effective component of HAP-based composites, improving the adhesion and serving as a drug carrier.[1] Inclusion of antibiotics into composite biomaterials has gained a lot of attention, as it is thus possible to achieve the desirable antibacterial activity. Gentamicin (Gent) was shown to be one of the most effective antibiotics in treating bone infections. In this work, bioceramic composite HAP/CS and HAP/CS/Gent coatings were successfully assembled on Ti plates by electrophoretic deposition technique (EPD).[2] Deposition was carried out at a constant voltage of 5 V and for 12 min in a single step process from three-component aqueous suspension (Figure 1). Bioactive properties of deposited coatings were investigated *in vitro*, by immersion in simulated body fluid solution (SBF). After 7-day immersion in SBF, field emission scanning electron microscopy (FE-SEM) and Fourier transform infrared spectroscopy (FTIR) were employed to investigate the coatings' bioactivity, whereas electrochemical impedance spectroscopy (EIS) and polarization measurements were carried out during 28-day immersion in SBF in order to obtain valuable information about osseopromotive coatings' nature. Biological testing included monitoring of alkaline phosphatase activity (ALP) that is associated with the coatings' ability to promote new bone growth. The high increase in ALP activity (50 %) relative to the control pointed to the strong coatings' aptitude for the osseointegration process and new bone growth. FTIR and FE-SEM analysis gave evidence of carbonate-substituted HAP, whose presence is desirable in bone implant applications. The formation of the new apatite layer was also confirmed by electrochemical measurements pointing to the high biomineralization potential of the coatings. Antibacterial activity kinetics in suspension against *Staphylococcus aureus* and *Escherichia coli* was also monitored to examine the potential coatings' application. As expected, the gentamicin addition strongly improved the antibacterial activity of HAP/CS/Gent coating, and the effect was more pronounced against *S. aureus.*
All the obtained results potentially indicated a strong osseointegration ability of the HAP/CS/Gent coating classifying it as a promising material for bone tissue engineering.

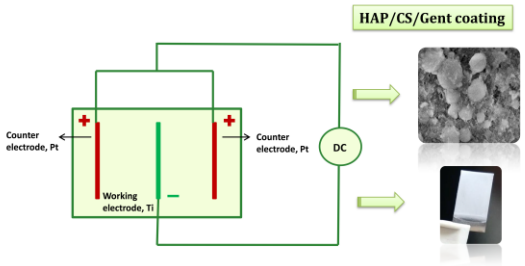


**Figure 1**. Electrophoretic deposition of composite HAP/CS/Gent coating

Reference:

[1] M. Đošić, S. Eraković, A. Janković, M. Vukašinović-Sekulić, I. Matić, J. Stojanović, K. Y. Rhee, V. Mišković-Stanković, S.J. Park, *J. Ind. Eng. Chem.* **2017**, *47*, 336–347.
[2] M. Stevanović, M. Đošić, A. Janković, V. Kojić, M. Vukašinović-Sekulić, J. Stojanović, J. Odović, M. Crevar Sakač, K. Y. Rhee, V. Mišković-Stanković, *ACS Biomater. Sci. Eng.* **2018**, *4*, 3994–4007.