



Development and Characterization of PCL Particulate Coating on Anodized Titanium Implant Surfaces Using Electrospraying Technique

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INTRODUCTION

- ❖ Success of an orthopedic or dental implant relies heavily on successful osseointegration.
- ❖ Titanium (Ti) and its alloys are commonly utilized in dental and orthopedic implants.
- ❖ Several methods, such as surface topography control, ceramic coating, and biomolecule immobilization have been explored to increase osseointegration.
- ❖ Anodized implants, because of their ability in osteoblast adhesion and osseointegration due to rough surface topography, have become very popular.
- ❖ Their effectiveness can be further enhanced by the addition of controlled delivery of fibroblast growth factor (FGF), bone morphogenic protein (BMP), and other biomolecules/drugs on the surface of the implant.
- ❖ Electrospraying is a cheap, relatively easy, but effective method of depositing micro and nanoparticles. The morphology of the electrosprayed particles can be easily controlled by changing parameters like the applied voltage, spinneret to collector distance, concentration of solution, tip diameter, etc.

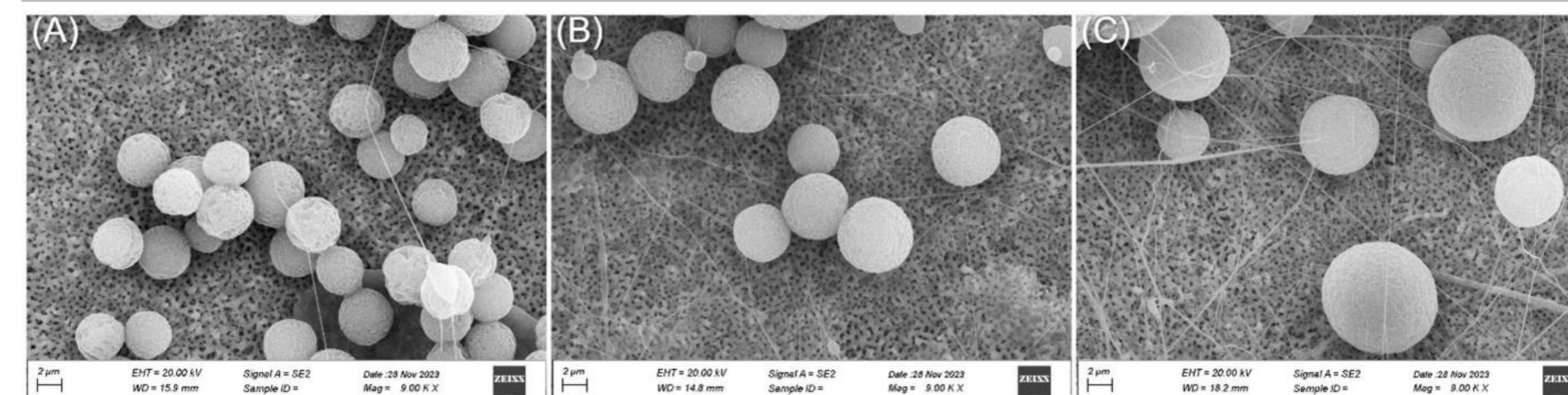
AIM

The aim of this study was to develop and characterize PCL particulate coating on anodized titanium implant surfaces using electrospraying technique. The long-term goal of this study is to evaluate its suitability in delivering biomolecules to enhance osseointegration.

MATERIALS & METHODS

- ❖ Anodized titanium samples were prepared in a pilot study by machine-cutting commercially pure titanium (Grade-4), polishing, and anodizing with phosphoric acid.
- ❖ PCL ($M_w = 80,000 \text{ g mol}^{-1}$) and chloroform (CF, $\geq 99.5\%$ pure) were bought from a commercial supplier. 2%, 4%, and 6% PCL in chloroform (w/v) solutions were prepared.
- ❖ PCL pellets were dissolved in chloroform using a bench rocker at room temperature. After 2 hours of rocking, homogenous solutions were obtained.
- ❖ 15 kV voltage, 12 cm spinneret-collector distance, and 0.7 ml/h flow rate were applied during electrospraying. A 16-gauge needle was used as the emitter. All solutions were sprayed for 10 minutes to ensure sufficient coating.
- ❖ The samples were then examined under a scanning electron microscope. The samples were prepared for SEM by sputter-coating with an 8.0 nm layer of Au-Pd.
- ❖ From each SEM image, the diameter of 30 random particles was measured using ImageJ software (U. S. National Institutes of Health, Bethesda, Maryland, USA). Finally, mean diameter was calculated for 2%, 4%, and 6% PCL in CF solutions.
- ❖ One-way ANOVA showed a statistically significant relationship between PCL concentration and particle size ($P < 0.01$).

FIGURE: SEM images showing obtained particles from (A) 2% PCL, (B) 4% PCL, and (C) 6% PCL in CF solutions. With the increase in concentration, larger particles and more fibers were observed.



RESULTS

Solution	Mean Particle Diameter (μm)
2% PCL in CF	4.268 ± 0.798
4% PCL in CF	6.44 ± 1.324
6% PCL in CF	8.523 ± 3.13

- ❖ Mean particle diameter increased with the increase of concentration.
- ❖ At a lower concentration (2%), more wrinkled particles formed.
- ❖ With the increase in concentration, more surface porosity was observed.
- ❖ More fibers were also observed with the increase in PCL concentration.

CONCLUSION

The size and morphology of the electrosprayed PCL particles on anodized titanium surfaces can be influenced by varying the concentration of the PCL solution.

Future research in this regard will involve testing with different solvents and concentrations, and the study of drug loading and releasing behavior of PCL particles.

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