

INTRODUCTION

- With the rising demand for dental implants, there is an increasing need to improve implant longevity.
- Titanium implants have a long history of successful use but lack an ideal surface for good osseointegration.
- Conventional plasma-sprayed hydroxyapatite coatings have been shown to improve osseointegration but are prone to delamination and implant failure.
- Anodized hydroxyapatite coatings, in contrast, have shown improved adhesion strengths.
- Calcium (Ca) and Magnesium (Mg) ions are critical bone tissue minerals and have been shown to promote osteoblast differentiation.

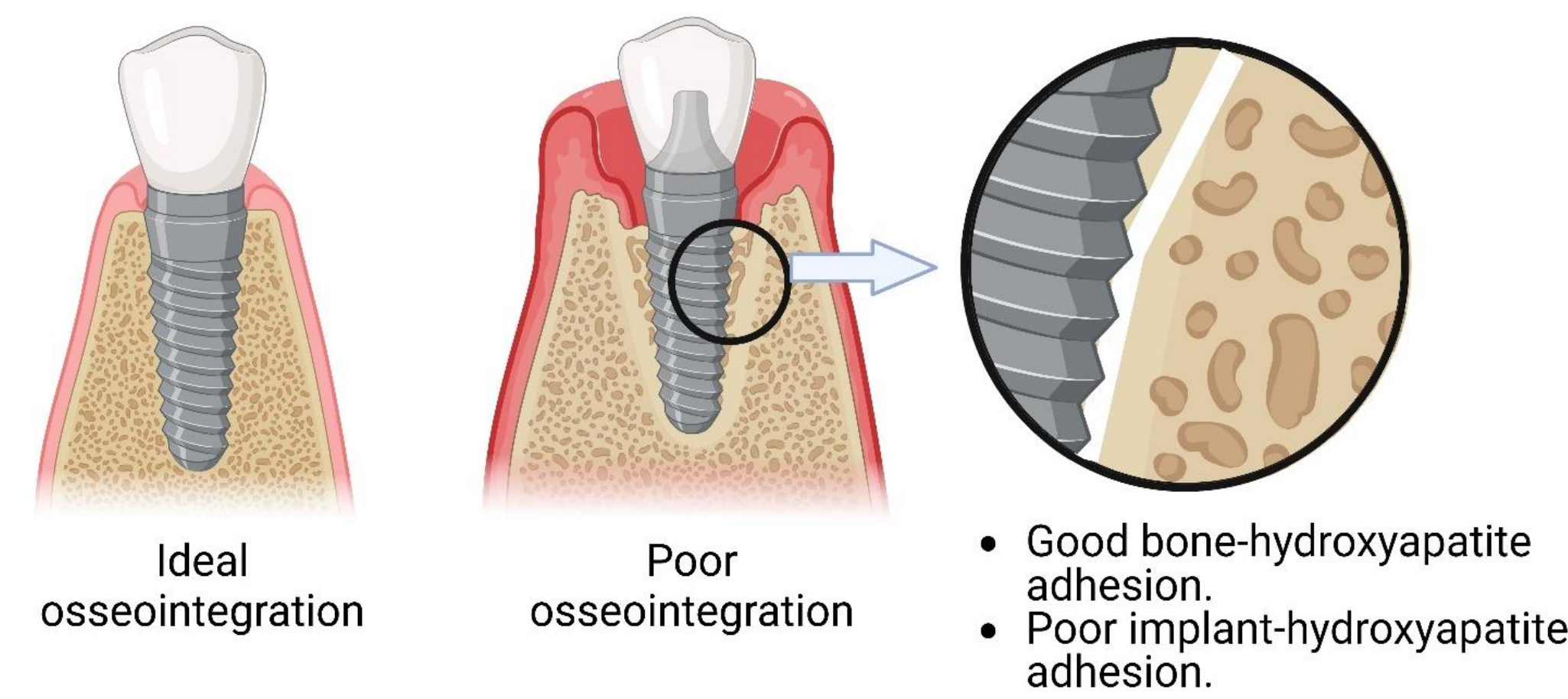


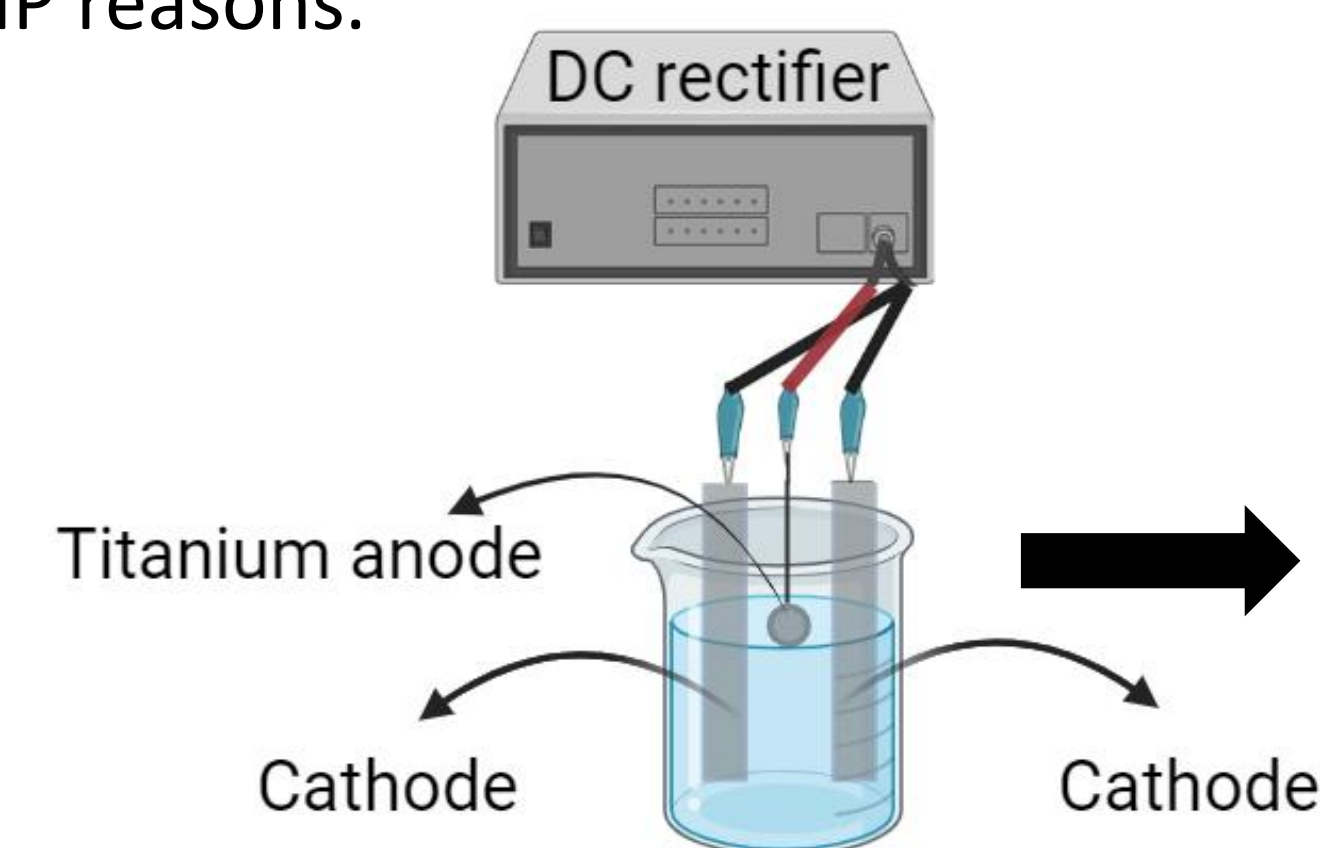
Figure 1 – Plasma sprayed hydroxyapatite coatings on titanium
Image - Created using Biorender.com

AIM

The aim of this research study was to create Ca and Mg releasing anodized hydroxyapatite coatings for improving osseointegration of dental implants.

MATERIALS AND METHODS

CP Titanium (CPTi) grade 4 discs were cut from 12.7 mm bar stock to a 3 mm thickness and acid etched to activate their surfaces. Activated discs (n = 4) were anodized in a proprietary electrolyte. The electrolyte composition and anodization waveform are not disclosed due to IP reasons.



Characterization of oxides:

- Scanning Electron Microscopy (SEM)
- Thin film x-ray diffraction (XRD)
- Fourier transform infrared spectroscopy (FTIR)
- Inductively Coupled Plasma Optical Emission Spectroscopy (ICP – OES)
- VDI 3198 standard Rockwell C indentation test

Figure 2 - Anodization (n=4)
Image - Created using Biorender.com

EXPERIMENTAL RESULTS

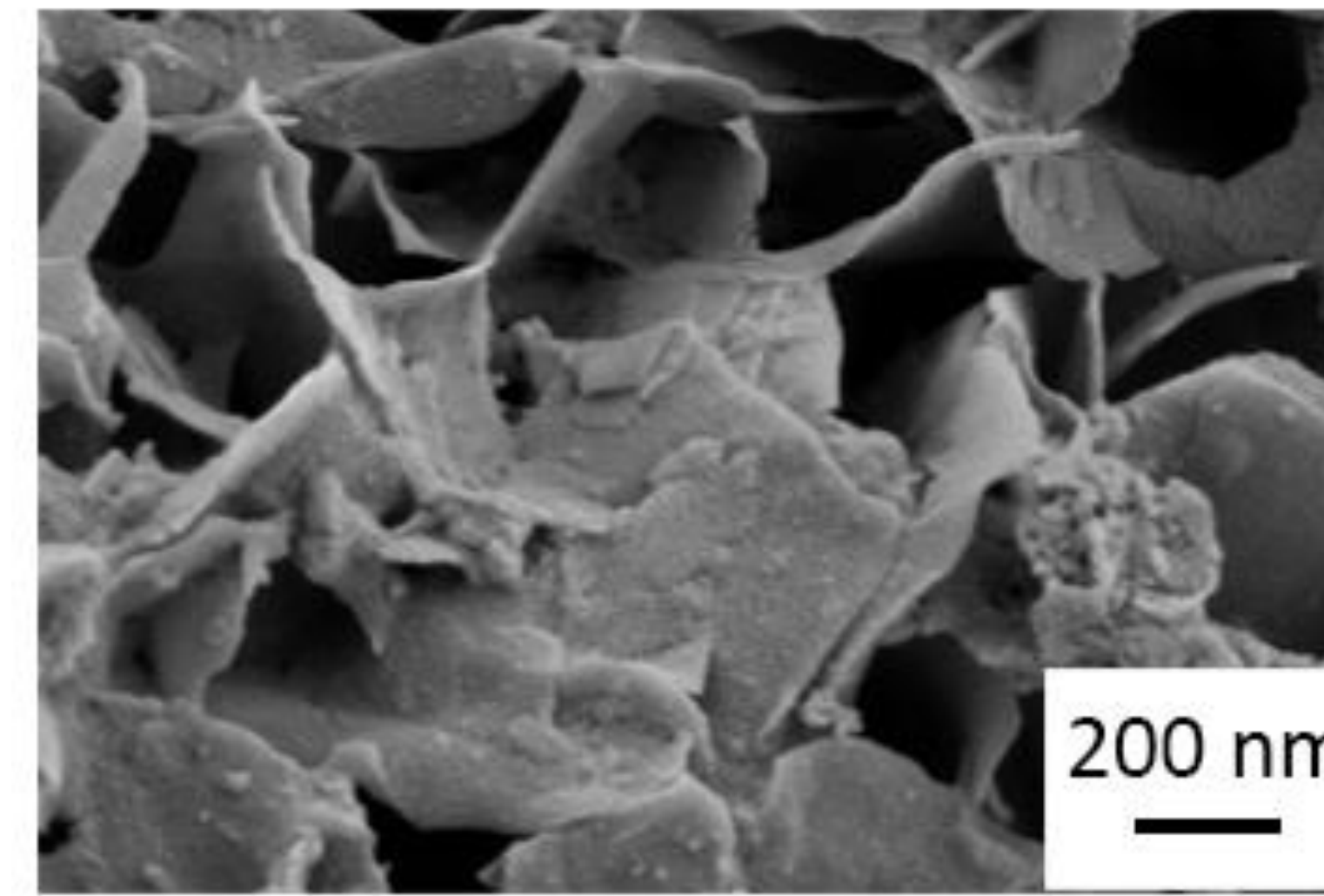


Figure 3 - SEM images revealed petal-like surface nanostructures

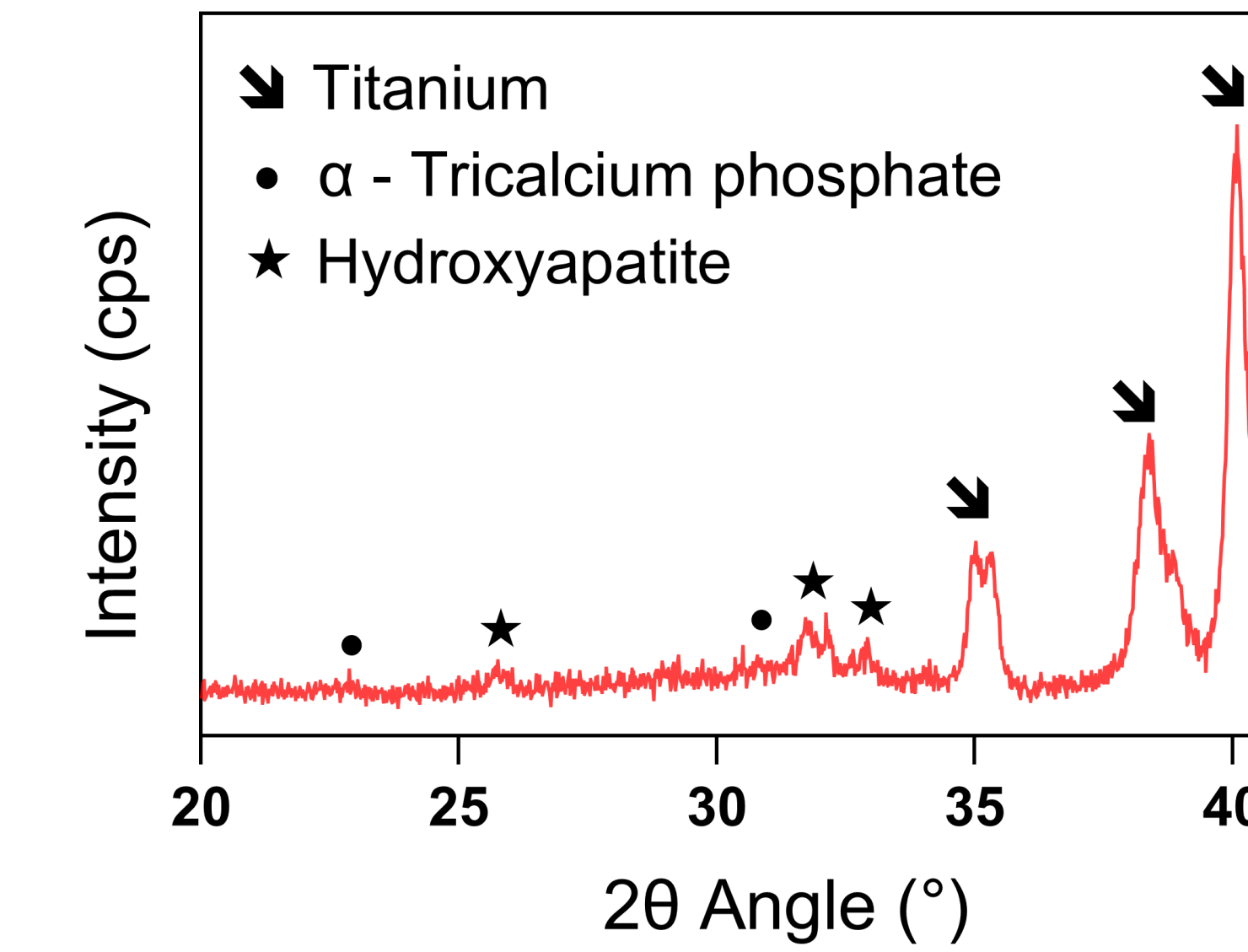


Figure 4 - XRD analyses revealed tri-calcium phosphate (α-TCP) and hydroxyapatite (HAp) crystalline compounds on the oxide surface

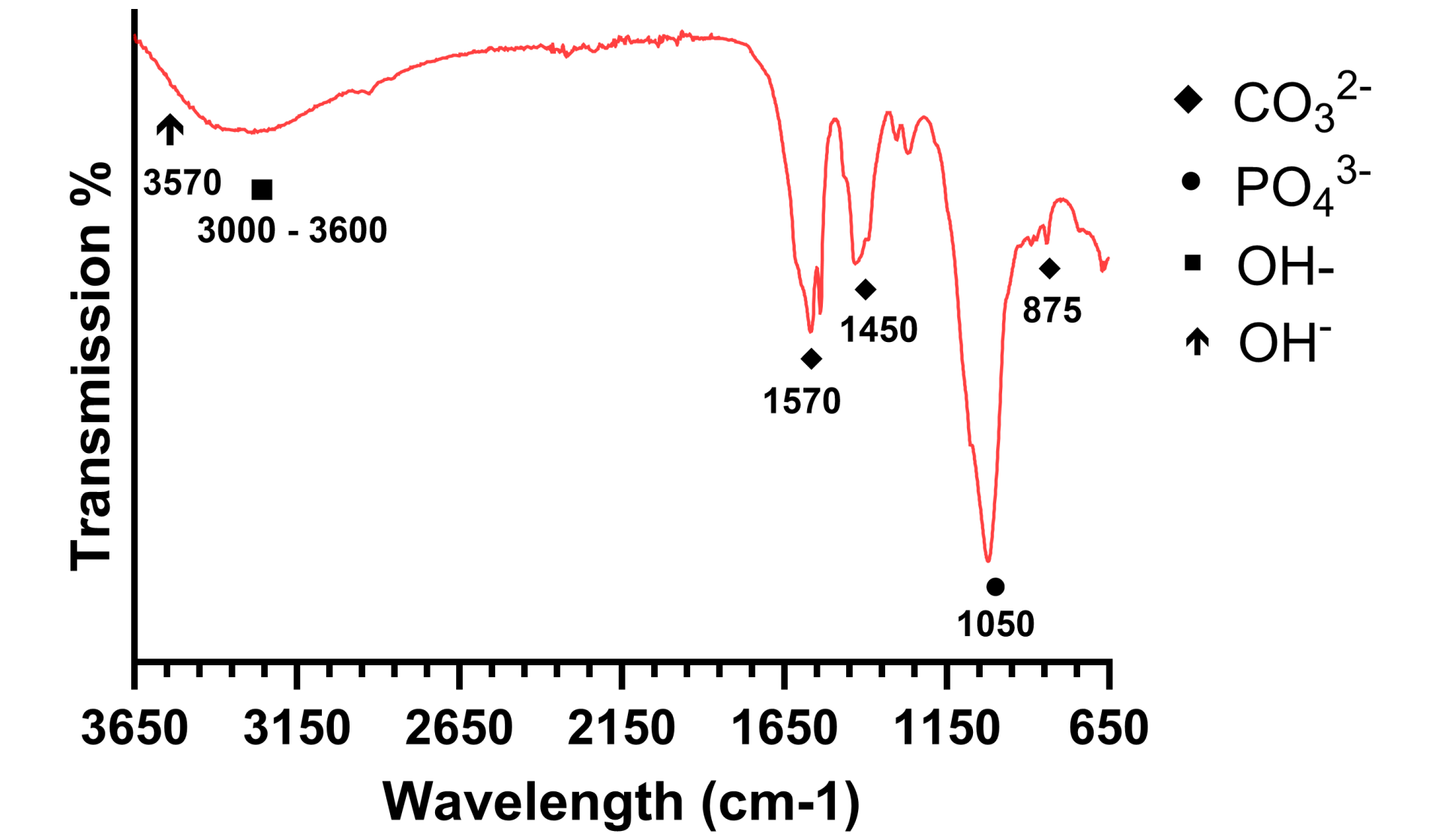


Figure 5 - FTIR analyses revealed carbonate substitution peaks representative of formation of bone-like carbonated apatite on the oxide surfaces

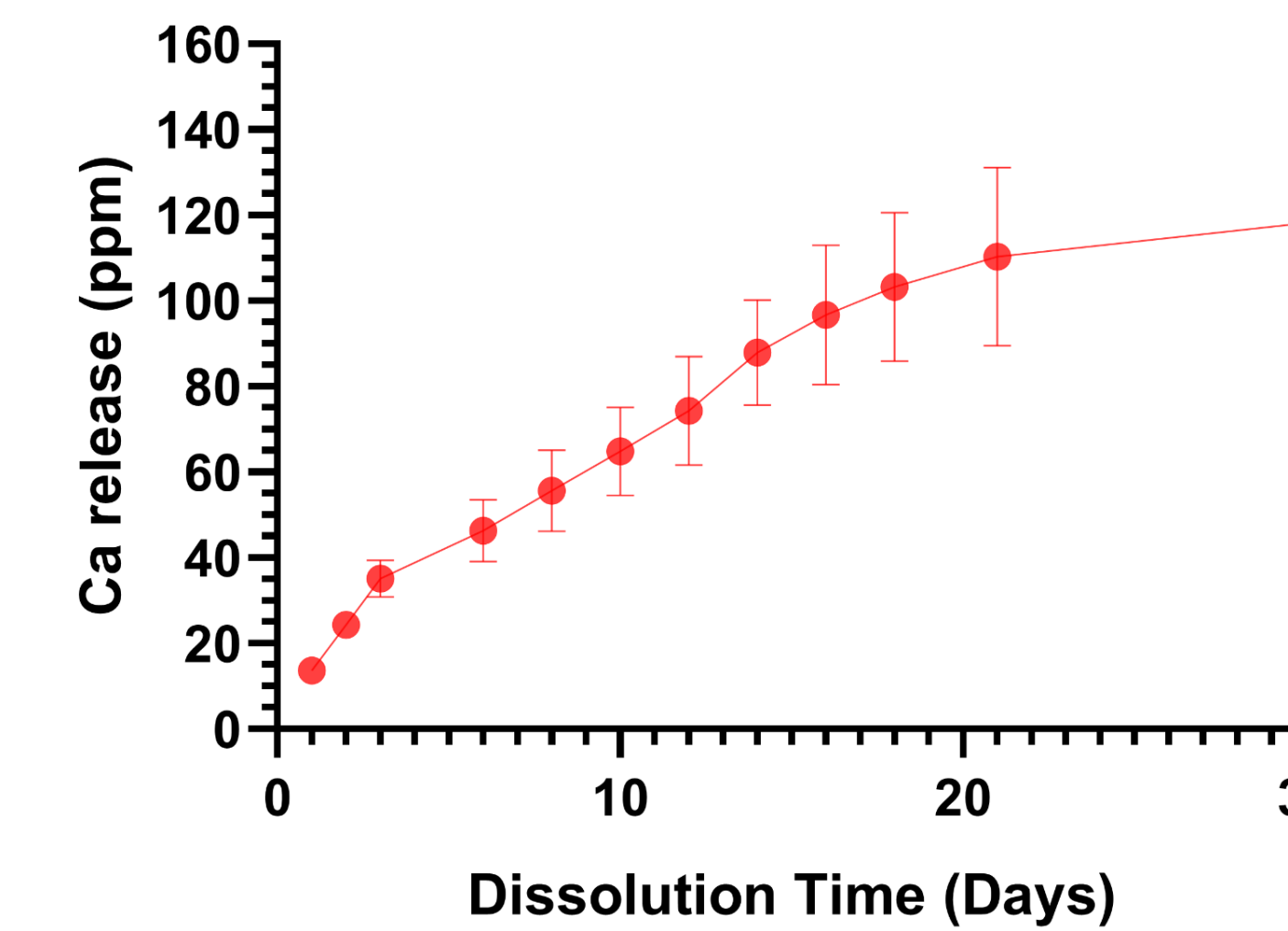


Figure 6 – ICP-OES revealed a sustained release of Ca and Mg ions over a 30-day period

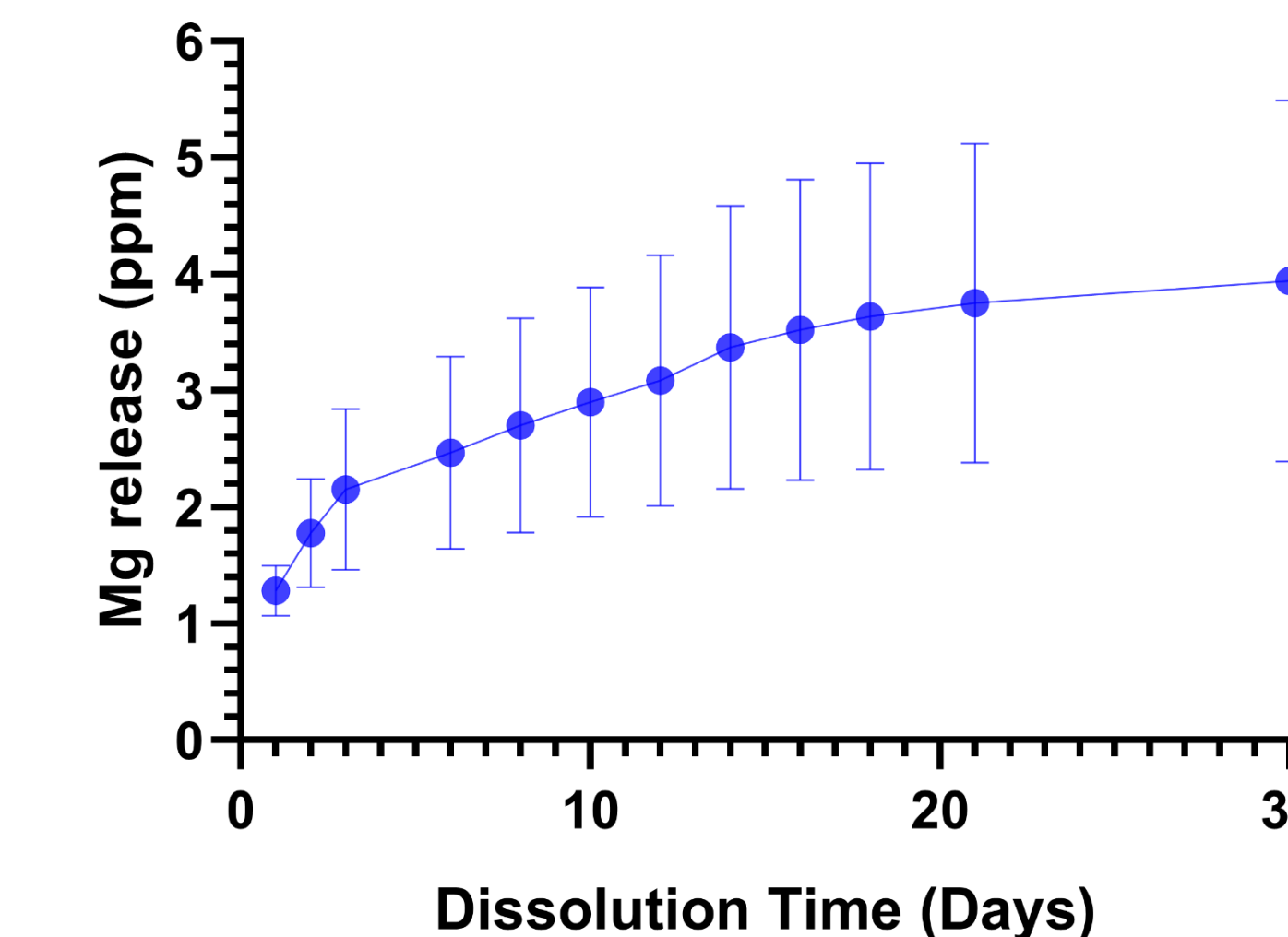
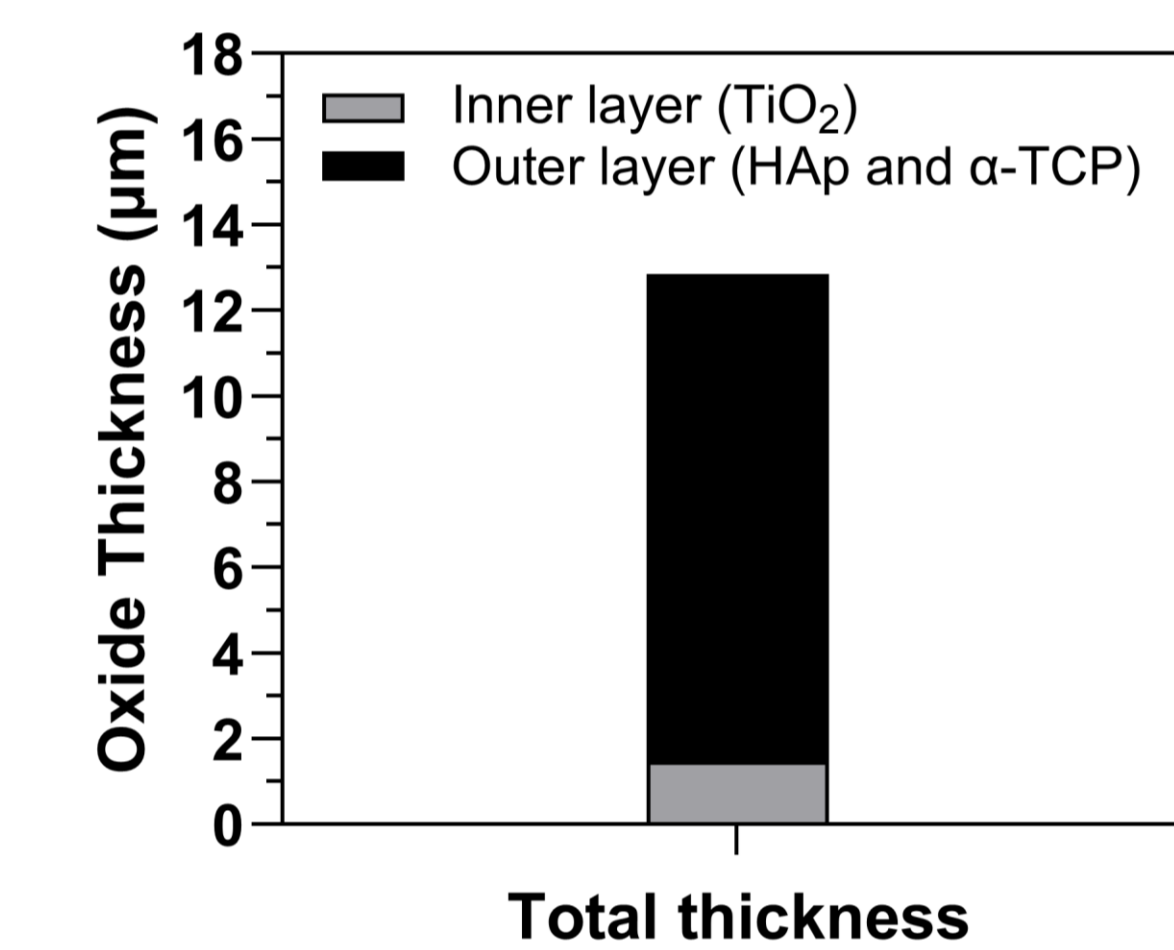


Figure 7 – SEM cross-sections revealed bi-layered thickness

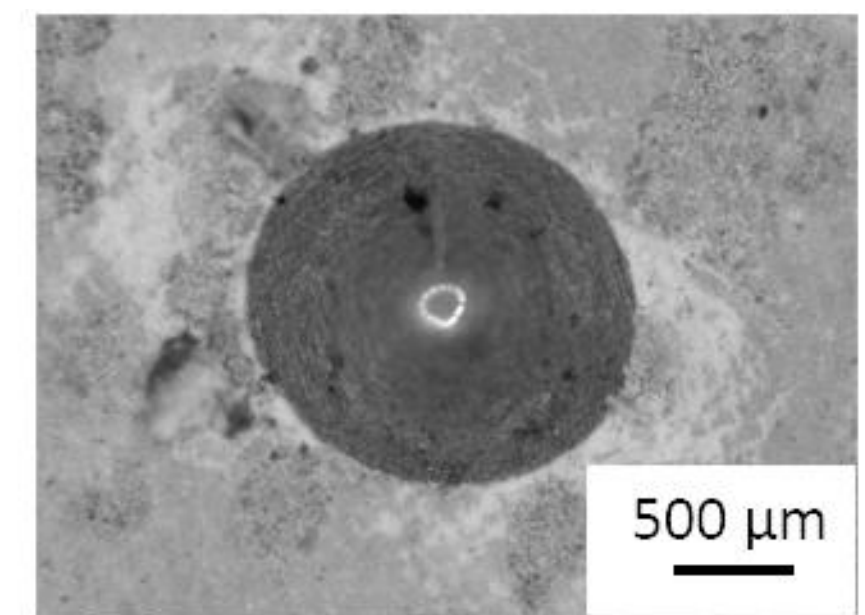


Figure 8 – VDI adhesion analysis revealed good oxide layer adhesion quality

CONCLUSION

The present study successfully formed Ca and Mg releasing carbonated apatite and tri-calcium phosphate coatings on titanium with acceptable adhesion strengths. Thus, these novel implant coatings show much promise to improve osseointegration and future patient outcomes.

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