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# Nanoscale characterization of the corrosion products of a biodegradable FeMnSi alloy: An in vitro study in simulated body fluid (SBF)

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## INTRODUCTION & AIM

The utilisation of FeMnSi biodegradables in contemporary medical applications is a promising avenue of research due to their capacity to degrade in physiological environments in a controlled manner, thus obviating the need for secondary surgical procedures. The study of corrosion mechanisms and degradation dynamics in vitro is essential to predict their behaviour under real body conditions, with the aim of optimising implant compatibility and functionality. It is hypothesised that corrosion should follow a kinetic profile synchronised with the tissue healing process. This would prevent premature metal ion release or loss of structural integrity.

## METHOD

The current work characterises a biodegradable FeMnSi-1.5Ag alloy in terms of its corrosion mechanism in simulated body fluid (SBF). The alloy under investigation was analysed after 72 h of immersion by scanning electron microscopy (SEM) and atomic force microscopy (AFM). EDX (Energy Dispersive X-ray) and nano-FTIR techniques were employed to investigate the corrosion compounds. The pH of the immersion solution was evaluated in accordance with the fluctuations corresponding to the chemical reactions caused by liquid–metal interactions.

## RESULTS & DISCUSSION

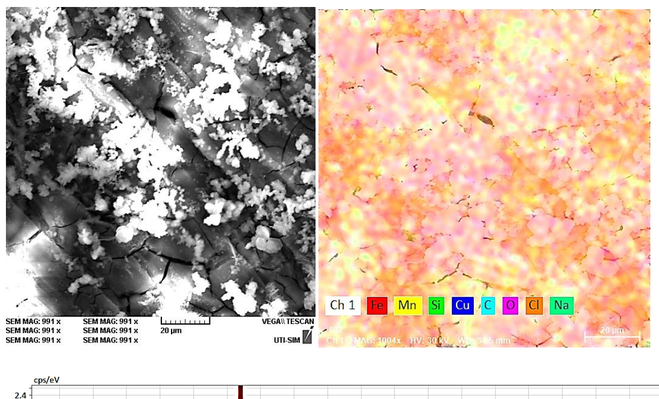


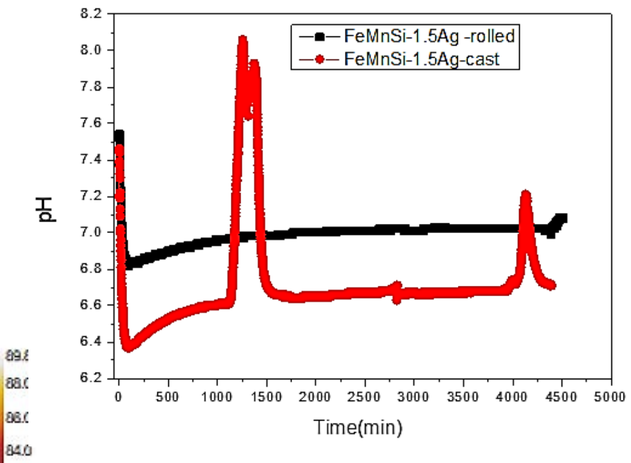

**Figure 1.** SEM and EDS images of the FeMnSi-1.5Ag samples, immersed for 14 days in SBF.

**Figure 2.** EDS spectrum displaying characteristic peaks for the chemical elements present in the FeMnSi-1.5Ag sample after 14 days in SBF.

The results obtained demonstrate the behaviour of the alloys in SBF and corroborate the pH variation consequent to the formation of compounds over time. The results indicated that the surface oxidised following immersion, along with the oxygen concentration increasing linearly with the sample's exposure to the liquid. In addition to oxygen, reactions with the medium revealed the presence of trace elements such as Ca, P, C, and Cl.

## RESULTS & DISCUSSION

**Figure 3.** pH variation recorded for 72 h of immersion in SBF.



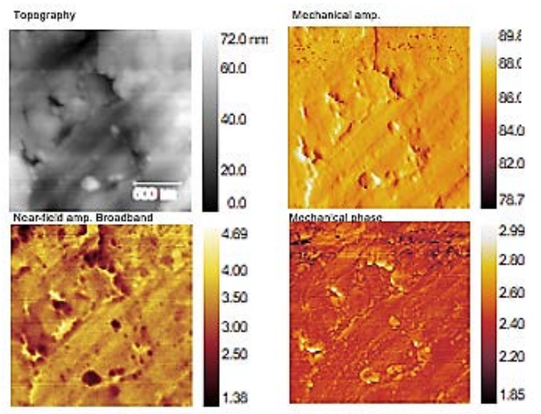




**Figure 4.** AFM images of the initial FeMnSi-Ag sample.

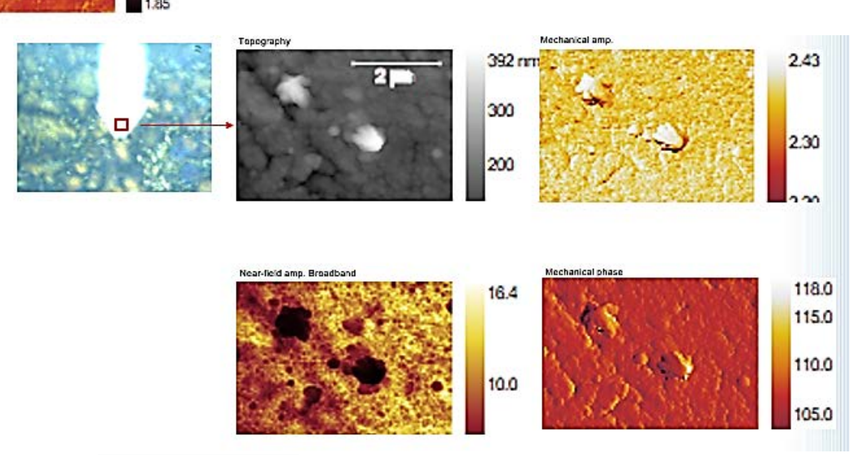



**Figure 5.** AFM images of the corroded FeMnSi-Ag sample.

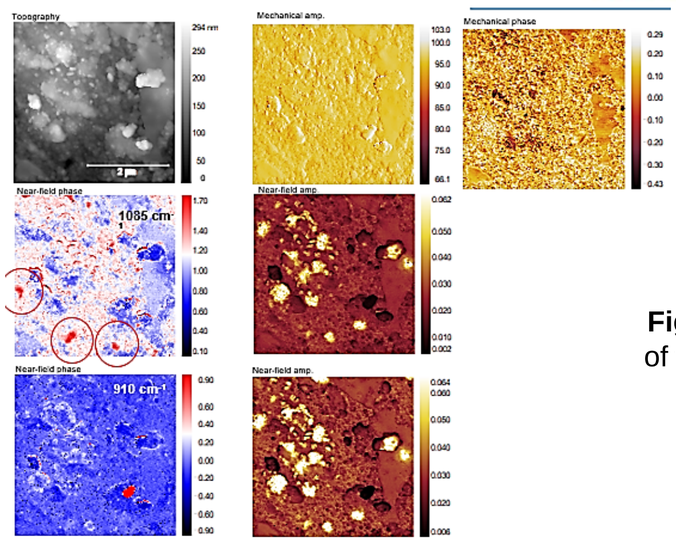



**Figure 6.** Near-field phase images of the corroded FeMnSi-Ag sample.

## CONCLUSION

Post-immersion characterisation revealed the presence of nanoscale corrosion products on the alloy surface, demonstrating the progression of corrosion from the nanoscale to the macroscopic level.

## REFERENCES

**References**
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