

Tantalum-Doped 58S Bioactive Glass Coatings for Corrosion-Resistant CoCrMo Implants

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INTRODUCTION

The increasing global demand for orthopedic implants highlights the relevance of cobalt-chromium-molybdenum (CoCrMo) alloys, recognized for their mechanical strength, corrosion resistance, and biocompatibility. Advances in additive manufacturing enable the fabrication of porous and lightweight implants, with 3D gyroid structures offering superior performance in orthopedic systems. Bioactive 58S glasses, composed of SiO₂, CaO, and P₂O₅, are extensively studied for their ability to interact with physiological fluids and generate bone-like apatite layers. Incorporation of tantalum further enhances their bioactivity and antibacterial properties, particularly in the 58S0.6Ta composition. This study integrates these developments by electrodepositing tantalum-doped 58S0.6 bioglass onto CoCrMo gyroid substrates and assessing their electrochemical behavior. The approach aims to strengthen corrosion resistance and promote in vitro bioactivity of porous CoCrMo implants.

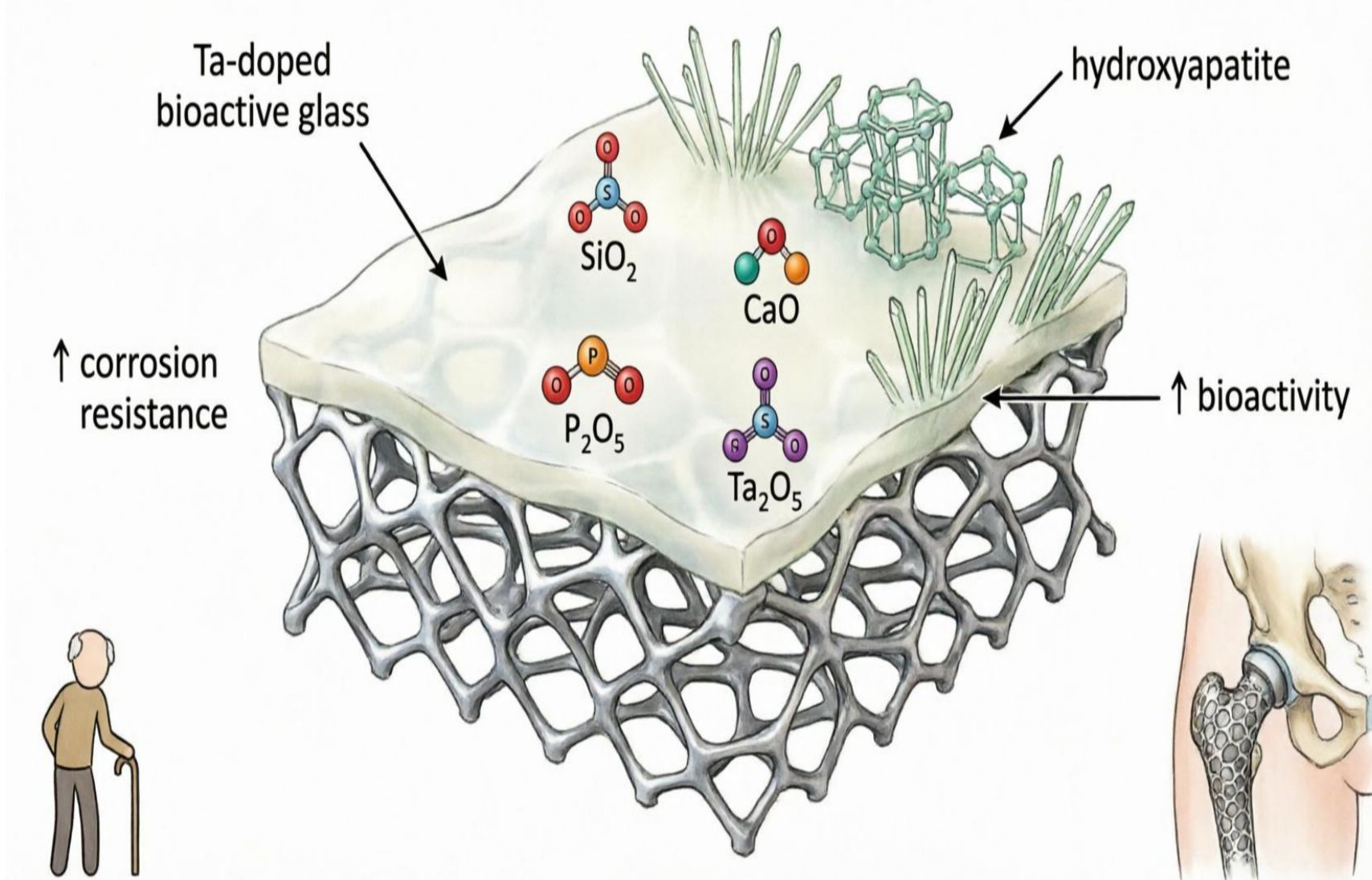


Fig. 1: Tantalum-doped 58S bioglass coated on a Gyroïde structure for orthopedic implants

CONCLUSION

- Porous CoCrMo alloys coated with 58S-0.6Ta bioglass via electrophoretic deposition show marked improvements in structure, morphology, and electrochemical behavior—key benefits for biomedical use.
- Analyses (TGA, XRD, FTIR, SEM) confirmed the homogeneous incorporation of tantalum into the 58S bioactive glass and the adhesion of the coatings to the CoCrMo alloy. Electrochemical tests in simulated body fluid showed a significant improvement in corrosion resistance.

Key Finding: Tantalum-doped 58S bioactive glass coatings, applied by electrophoretic deposition onto porous CoCrMo alloys, enhance structural integrity, surface morphology, corrosion resistance, and biocompatibility, highlighting their strong potential for orthopedic implant applications.

MATERIALS & METHODS

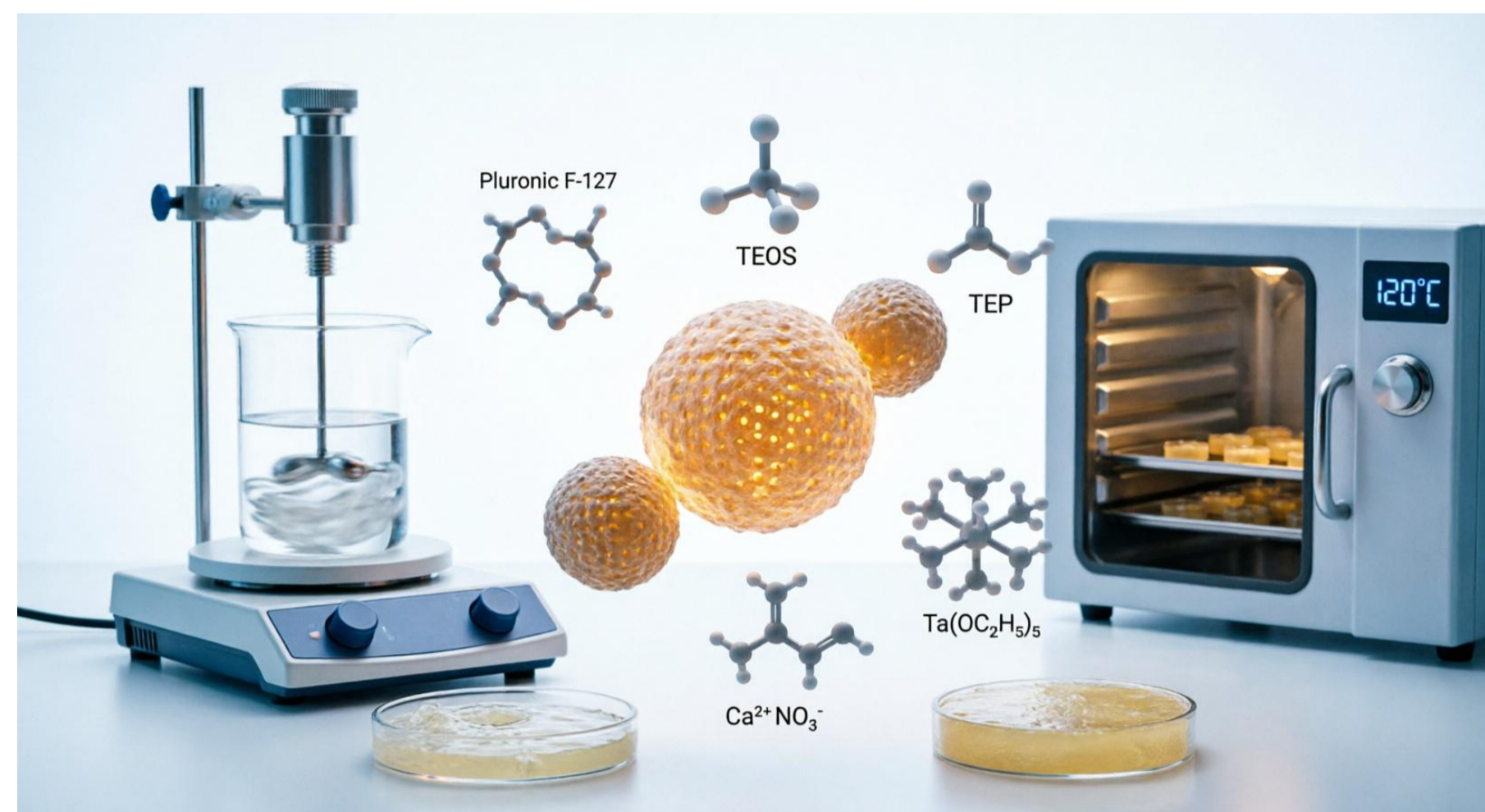


Fig. 2: the EISA procedure for the synthesis of bioglass 58S

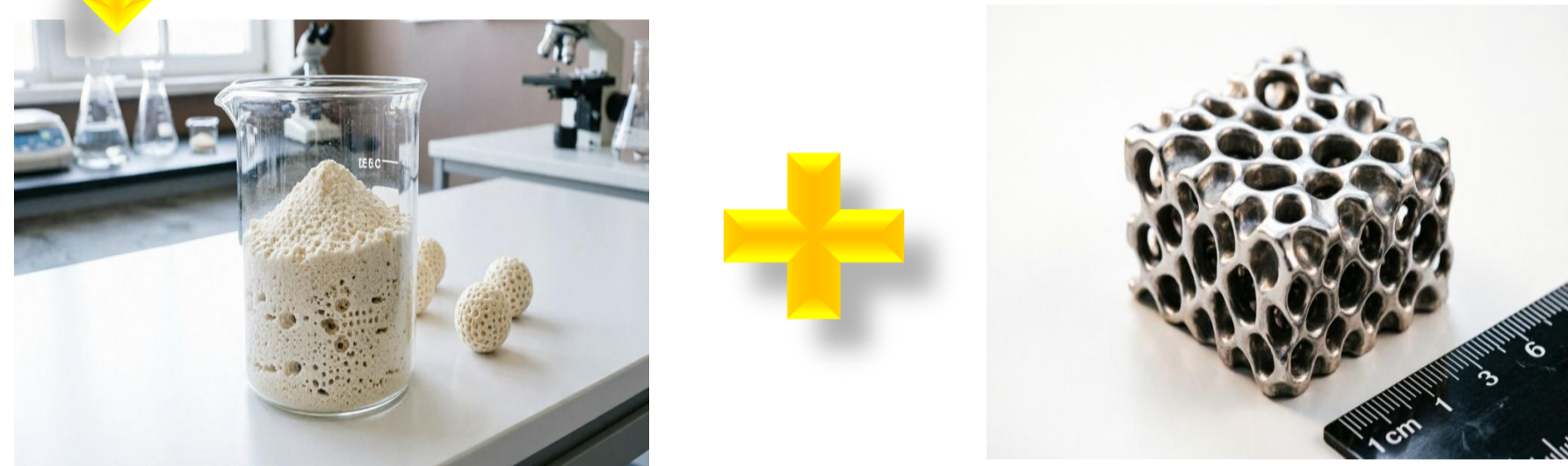
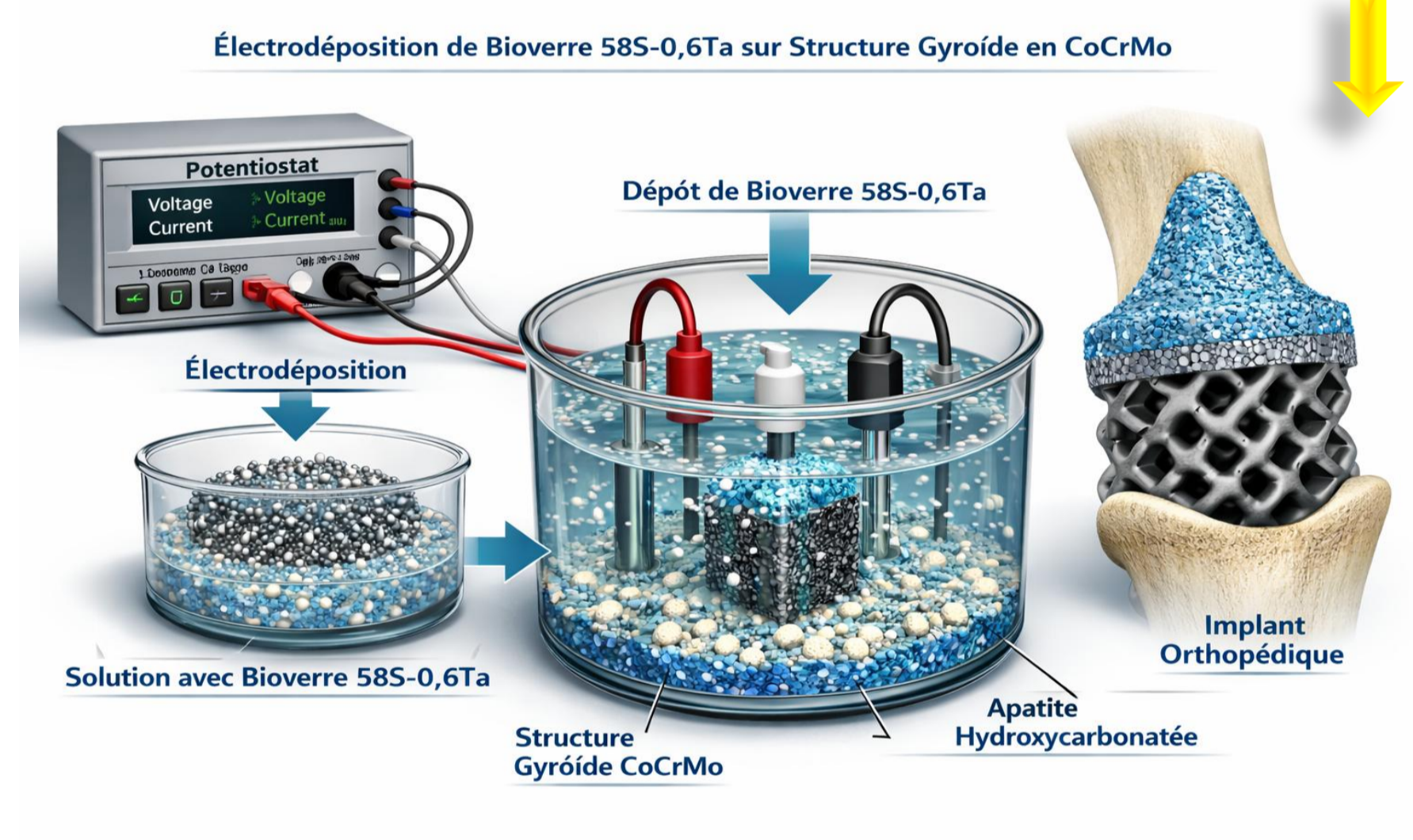


Fig. 3 : nanometric grains of bioactive glass

Fig. 4 : porous CoCrMo alloy structure



RESULTS & DISCUSSION

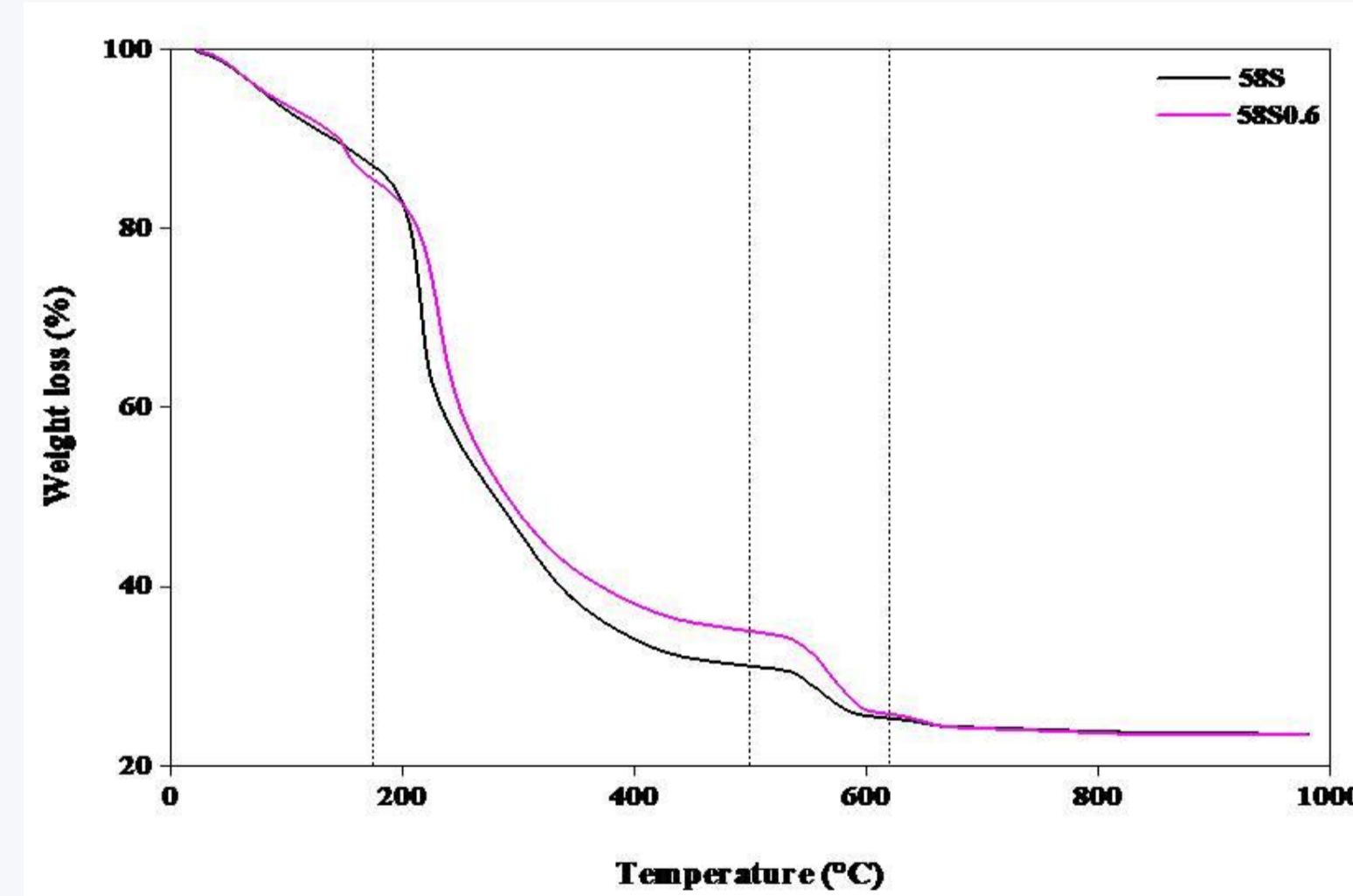


Fig. 5 : TGA curves of 58S powder with and without tantalum

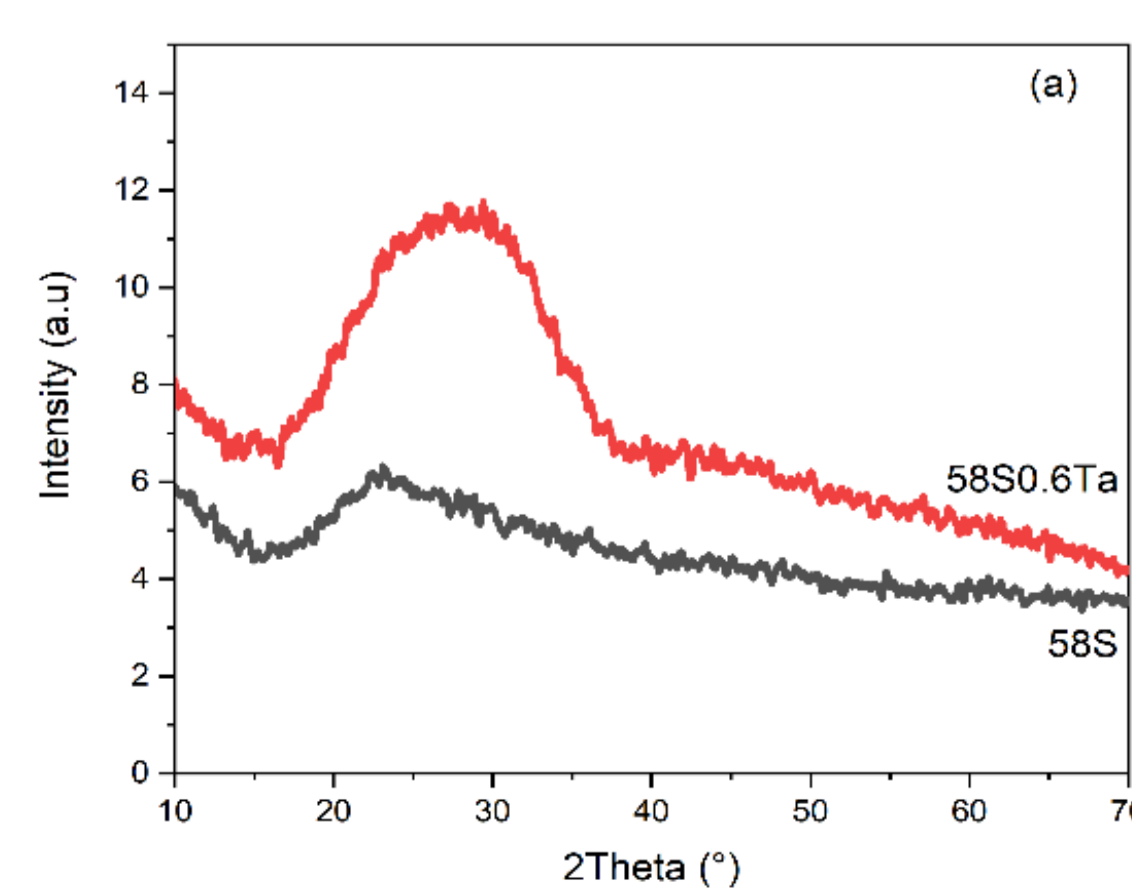


Fig. 6 : XRD curves of 58S powder with and without tantalum

RESULTS (CONTINUED)

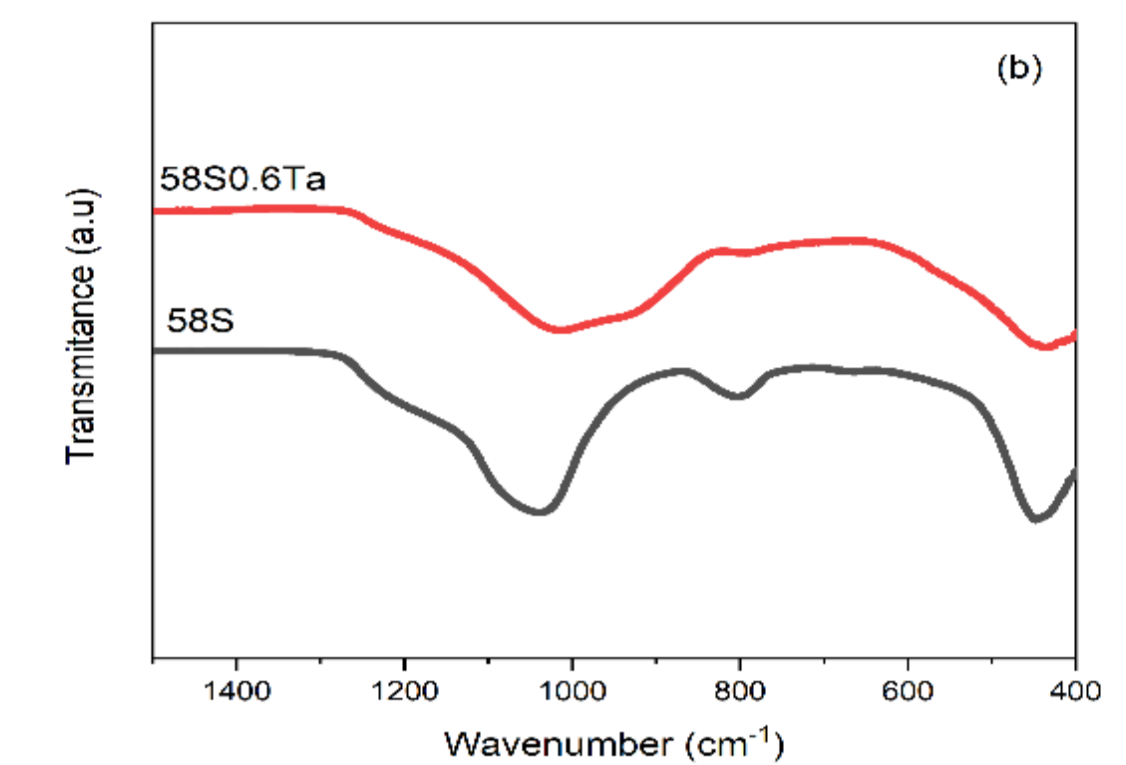


Fig. 7: (FT-IR) spectra showing characteristic functional groups.

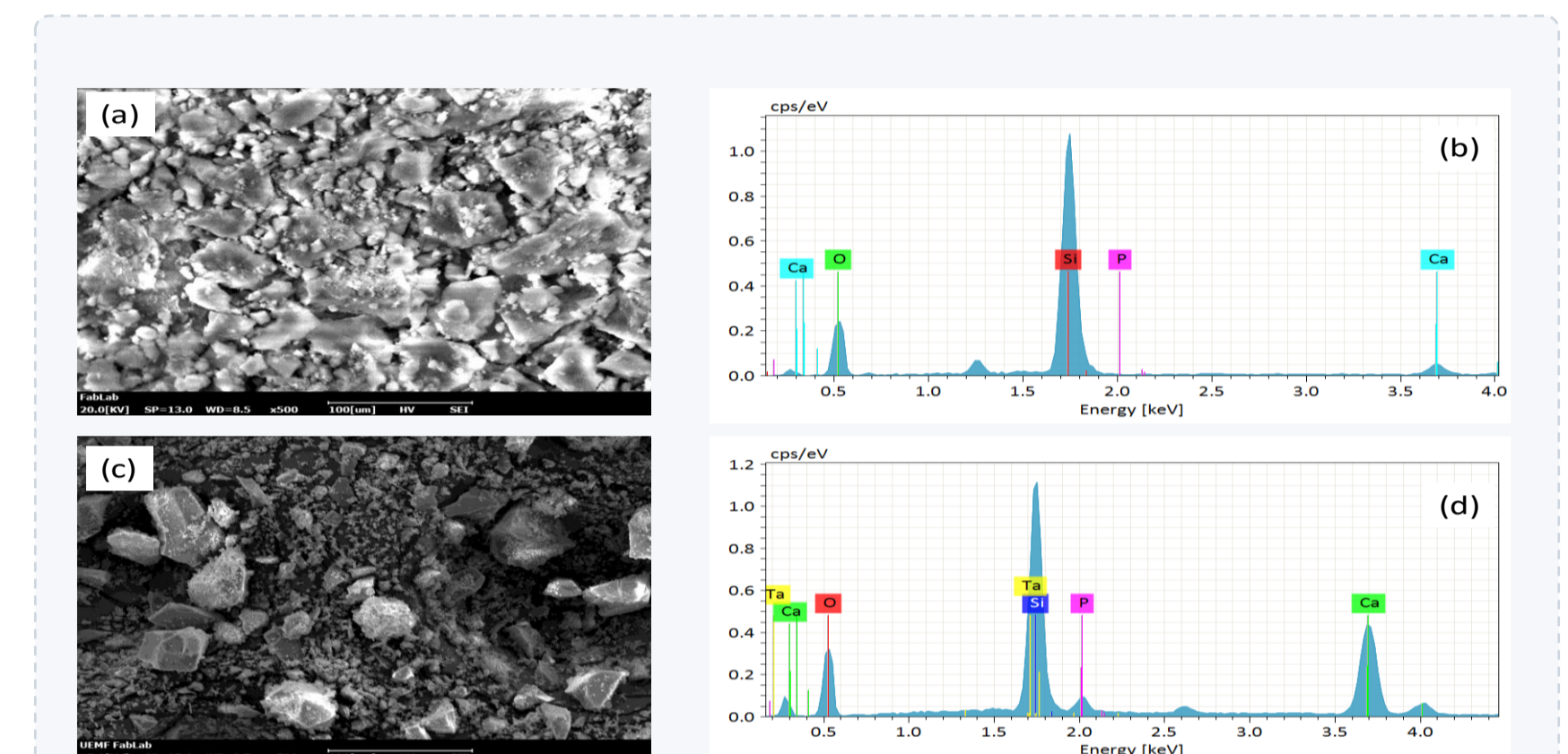


Fig. 8: MEB-EDX of the 58S bioglass with and without Tantalum

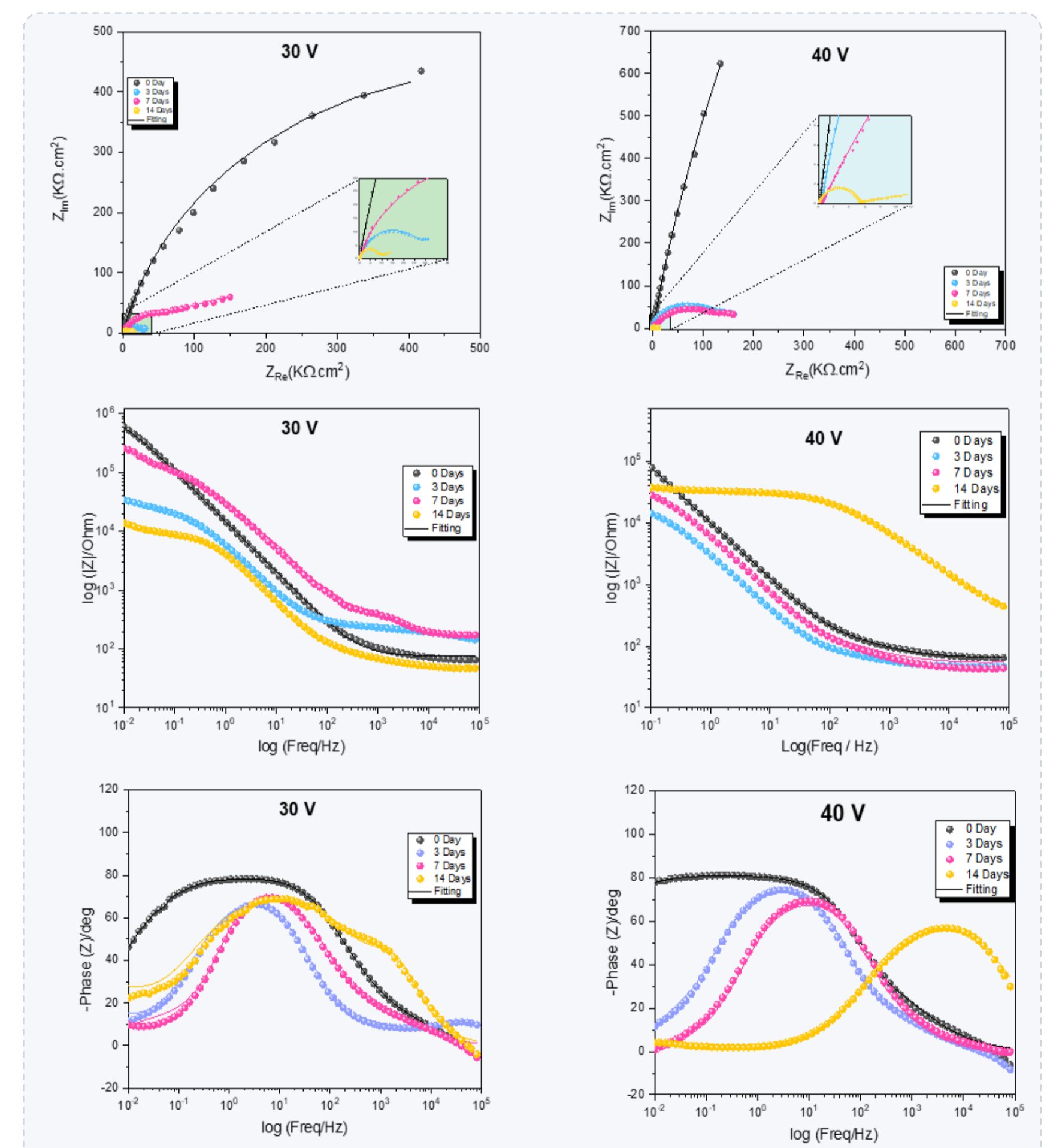


Fig. 9 : CoCrMo coating impedance curve with tantalum-doped bioglass

REFERENCES

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