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Surface Modification of Medium Entropy Alloys

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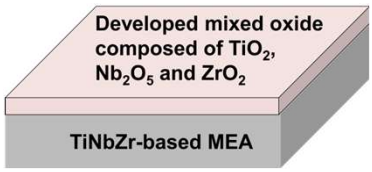
INTRODUCTION & AIM



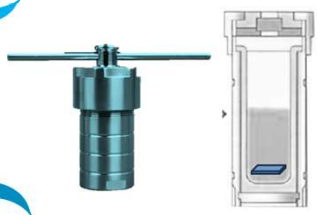
- A medium entropy alloy (MEA) is typically an alloy composed of 2 to 4 principal elements in roughly equal proportions[1].
- Bio-MEAs are relevant for implant applications due to their combination of mechanical properties, and ability to be fabricated with multiple biocompatible elements capable of generating a mixed oxide surface[2].

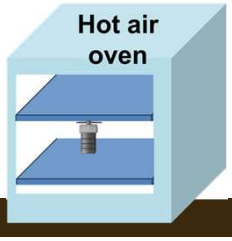
The main aim of this work is to modify the surface of MEA (NbTiZr-based), to develop a mixed oxide surface composed of Nb, Ti and Zr for improved biocompatibility by a facile hydrothermal technique

METHOD

Polished MEA sample subjected to cleaning by ultrasonication

Cleaned samples placed in a Teflon limed stainless steel autoclave filled with 0.5 M NaOH in deionized water





Hydrothermal treatment conducted at 200°C for 2h

RESULTS & DISCUSSION

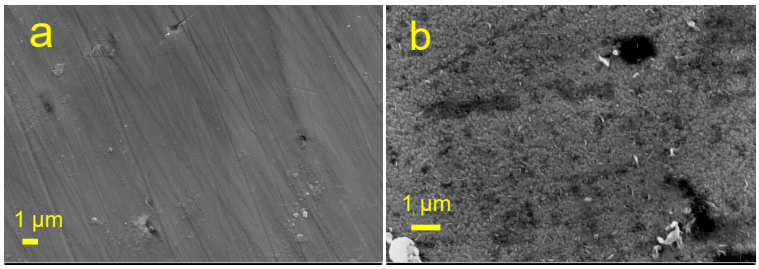
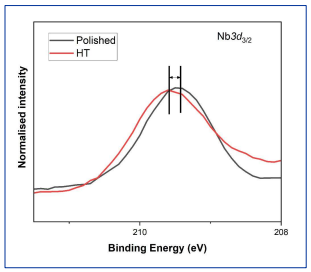


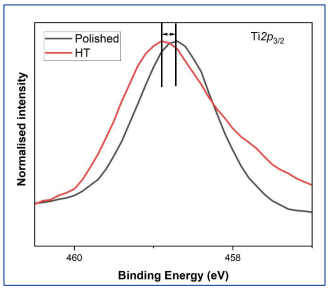
Fig. a) SEM image of polished sample, b) nanomorphologies developed by HT on MEA surface

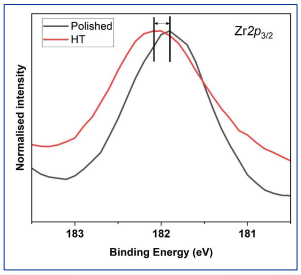
X-ray Photoelectron Spectroscopy Analysis



$$TiO_2 + 2OH^- + 2e^- \rightarrow Ti(OH)_2$$
$$TiO_2 + e^- \rightarrow Ti^{3+} + O^-$$
$$TiO_2 + OH^- + e^- \rightarrow Ti^{3+} - OH + O^{2-}$$

$$Nb_2O_5 + 2OH + 2e^- \rightarrow 2NbO_2 + H_2O$$
$$Nb_2O_5 + 2OH^- + 2e^- \rightarrow 2Nb^{4+} - OH + O^{2-}$$
$$Nb_2O_5 + 2\,H_2O + 2e^- \rightarrow 2NbO_2 + 4OH^-$$





$$ZrO_2 + 2OH^- + 2e^- \rightarrow Zr(OH)_2 + O^{2-}$$
$$ZrO_2 + 2H_2O + 4e^- \rightarrow Zr + 4OH^-$$
$$ZrO_2 + e^- \rightarrow Zr^{3+} + O^-$$

CONCLUSION

The work successfully developed a mixed oxide surface composed of Ti, Nb and Zr oxides with nanomorphologies beneficial for implant applications

FUTURE WORK / REFERENCES

Understanding the biocompatibility aspects of the developed surface

References

1. Chang, L.; Jing, H.; Liu, C.; Qiu, C.; Ling, X. *Adv. Sci.* 2024, 11, 2406521.
2. Gueye, M.; Ammar-Merah, S.; Nowak, S.; Decorse, P.; Chevillot-Biraud, A.; Perrière, L.; Couzinie, J.P.; Guillot, I.; Dirras, G. *Surf. Coat. Technol.* 2020, 385, 125374.