Preparation and properties of the nanocrystalline Ti-6Zr-4Nb alloy with Ca-P coating as a biomaterial for hard tissue implant applications

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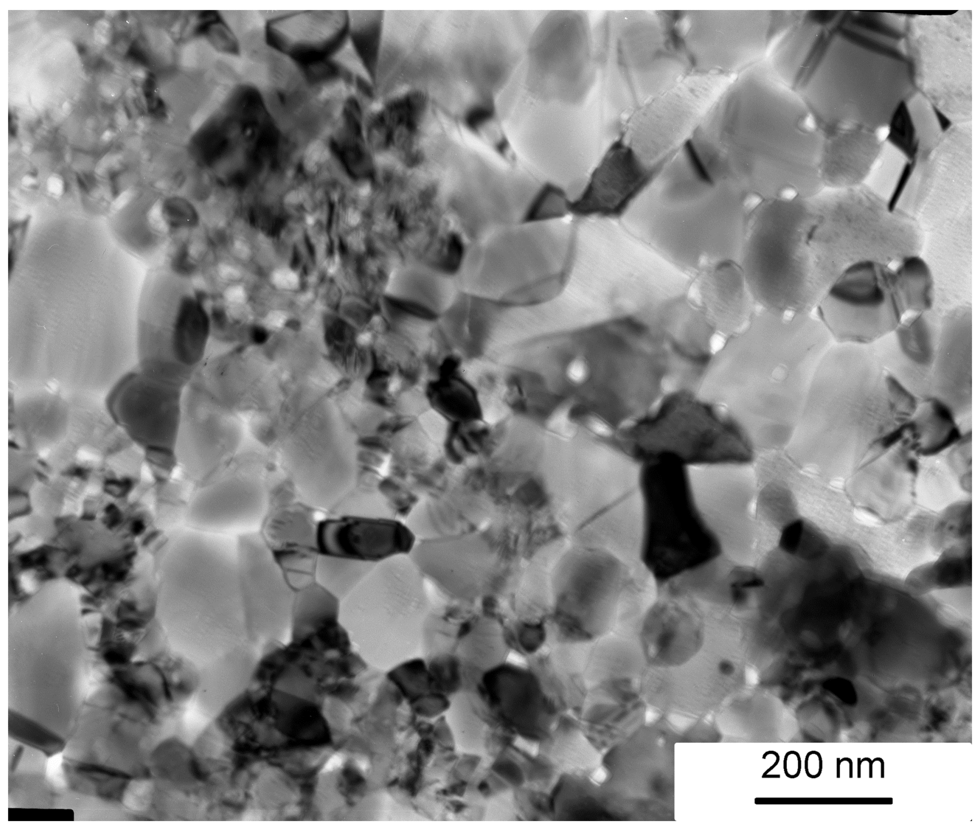
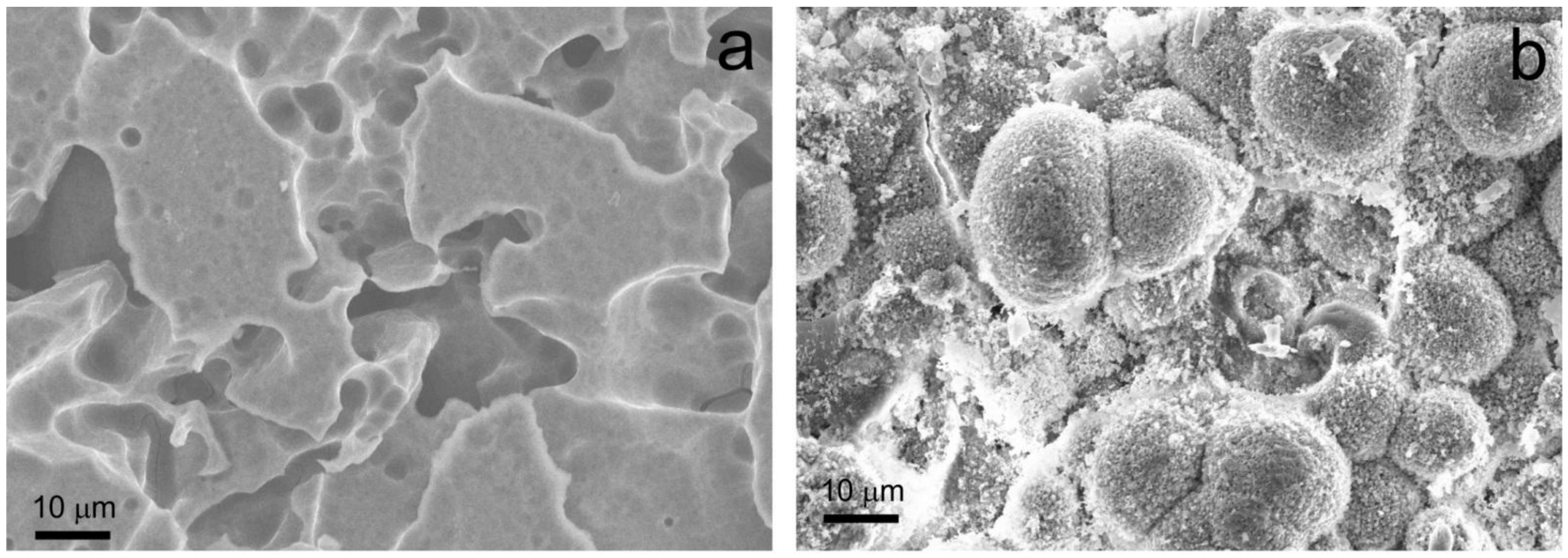


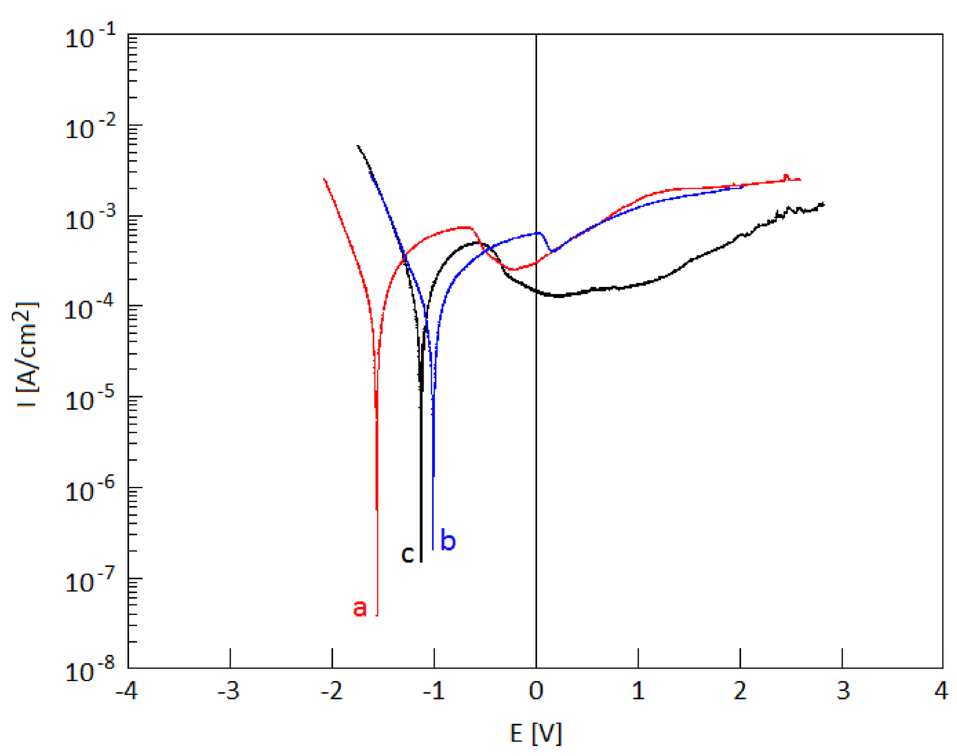
TEM image of Ti-6Zr-4Nb after MA and sintering at 800°C/1h



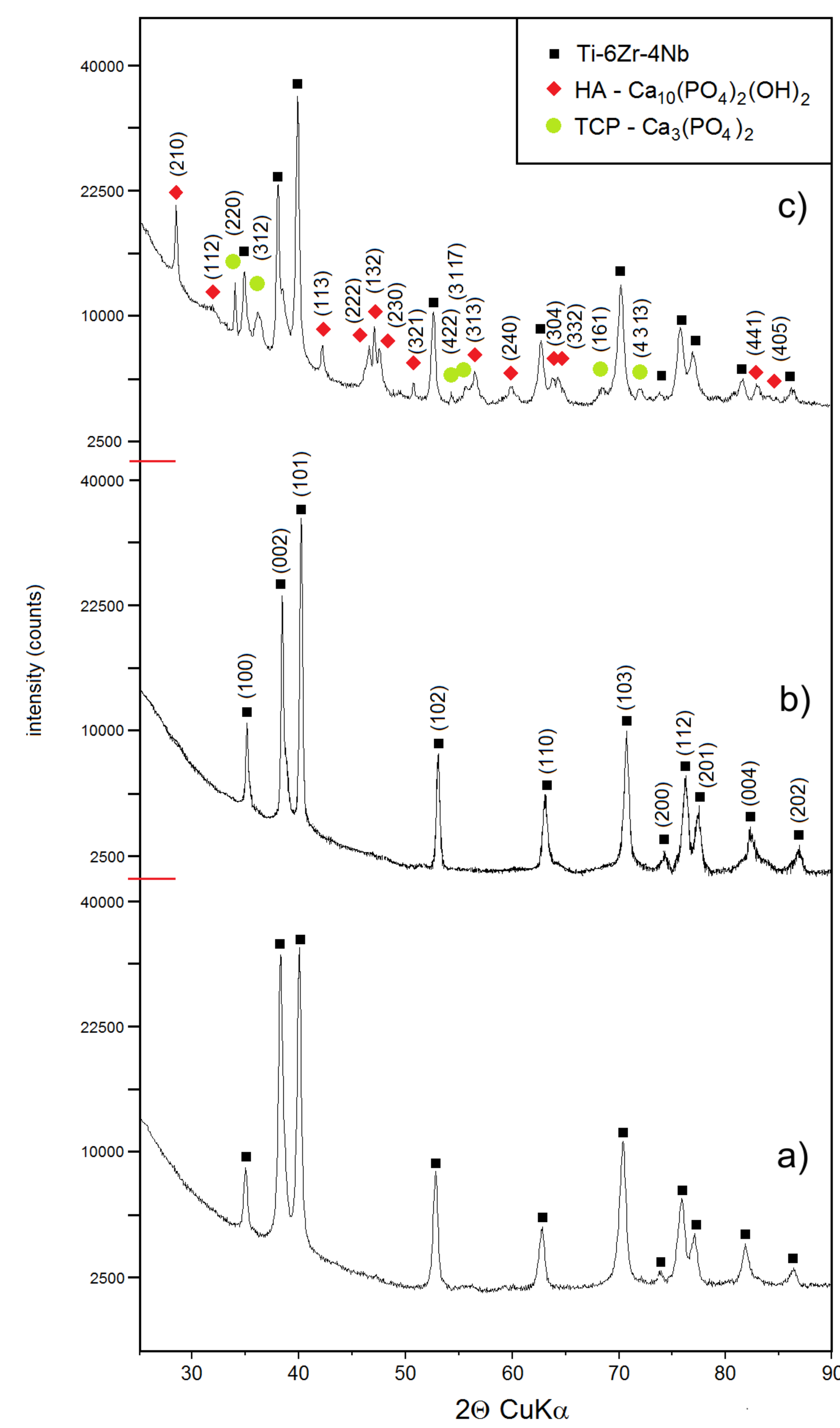
Surface of the nano-Ti–6Zr–4Nb after anodic oxidation (a) and additional Ca–P deposition (b).

Formation of the Ti-6Zr-4Nb porous nanocrystalline alloy with Ca-P coating was described. The alloy was prepared by mechanical alloying followed by pressing and sintering. The porous bioactive surface was produced in two steps electrochemical treatment: anodic oxidation in 1M H_3PO_4 + 2% HF electrolyte at 10V for 30min and subsequent cathodic Ca-P layer deposition at -5V for 1h, using a solution mixture of $Ca(NO_3)_2$ + $(NH_4)_2HPO_4$ + HCl. The microstructure and morphology of the biofunctionalized surface was studied by TEM, XRD, SEM, and optical profiler. The corrosion potentiodynamic tests were performed in Ringer's solution. The corrosion current density does not significantly change after surface modification, indicating good corrosion resistance of the biofunctionalized surfaces. Biocompatibility was investigated by in vitro tests using normal human osteoblasts (NHOst) which showed good cells behavior. The nanocrystalline Ti-6Zr-4Nb alloy with modified surface is a possible candidate for hard tissue implant application.

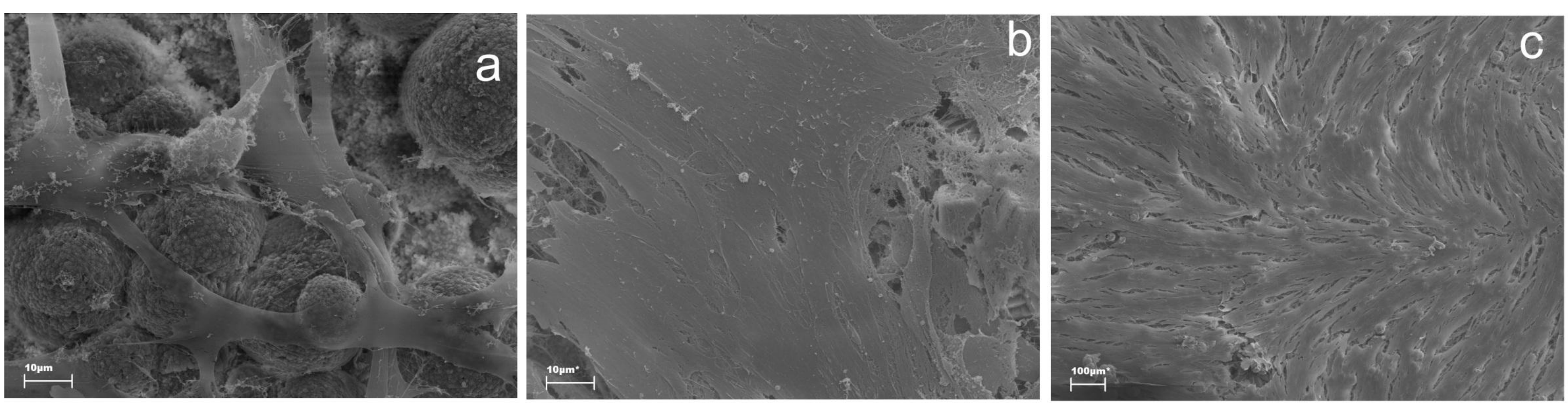
Material	I_{corr} [A/cm²]	E_{corr} [V]
Ti-6Zr-4Nb before anodic oxidation	2.27×10^{-6}	-0.82
Ti-6Zr-4Nb after anodic oxidation	4.43×10^{-6}	-0.75
Ti-6Zr-4Nb after a.o. with Ca-P	5.74×10^{-6}	-0.89



Corrosion curves and corrosion current density I_{corr} and potential E_{corr} of the nano-Ti–6Zr–4Nb before (a), after anodic oxidation (b) and after additional Ca–P deposition (c)



XRD of the nano-Ti–6Zr–4Nb before (a), after anodic oxidation (b) and after additional Ca–P deposition (c)



Osteoblast culture on the surface of the nano-Ti–6Zr–4Nb after anodic oxidation and additional Ca–P deposition after 1st (a) and 5th day (b, c—different magnifications)