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Investigation of hydrogen distribution in hybrid Ti-Mg implant materials using neutron tomography

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Hybrid implant materials consisting of a permanent Ti-based part combined with a degradable Mg part, where the Ti is used for its high strength while the temporary part is used for bone stimulation or drug delivery, are promising solutions to improve biocompatibility and stability of current implants. As Mg degrades hydrogen gas is released which ingresses into the Ti part, leading to changes in its properties. The profile of hydrogen distribution is a critical parameter for the biocompatibility and mechanical stability of Ti parts, especially in long-term applications. Macroscopic measurements by gas fusion technique showed that the profile of hydrogen absorption is not constant, with a maxima at the region between Mg, Ti and solvent contact [1]. To investigate this phenomenon on microscopic scale, sintered hybrid samples prepared using metal injection molding were subjected to saline degradation for a period of 0 to 120 hours. These samples were then characterized using neutron tomography performed at the ICON and NEUTRA instruments of SINQ (PSI, Switzerland) to study the spatial distribution (pixel size ~ 33 µm and 14 µm) of hydrogen in the Ti-part. Neutron data are in agreement with gas fusion results and additionally characterize H penetration profile normal to Ti-Mg interface.

1. Garamus, V.M. et. al. Metals 2021, 11, 527. 10.3390/met11040527

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