Static recrystallization of biodegradable zinc alloy using in situ and ex situ heating experiments

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Zinc is recognized as a promising candidate for biodegradable bone implants and cardiovascular stents due to its suitable corrosion rate. However, there remains a lack of comprehensive research quantifying how factors such as annealing temperature, alloying elements, and second-phase particles affect the recrystallization behavior and mechanical properties of zinc-based alloys. Furthermore, it is crucial to assess the thermal stability of low-alloyed zinc after undergoing plastic deformation, especially considering body temperature and the potential exposure to higher temperatures during transportation and storage of the final products.

The primary aim of this study was to examine the thermal stability of pure zinc and zinc alloys after hydrostatic extrusion.

Ex-situ microstructural studies were carried out on samples heated in a Memmert UNE 400 drying oven at 50°C, 100°C, and 150°C for 1 hour, followed by air cooling. Additionally, the 4D-STEM TESCAN TENSOR was used to obtain orientation maps of samples before and after heating up to 200°C for 1 hour through precession assistance, allowing the characterisation of the intermetallic phase (Mg_2Zn_{11}), as well as the grain size and orientations of the eutectic mixture.

In-situ SEM/EBSD studies were performed using the TANIST TESCAN system. Samples were maintained at 100°C for 48 hours, with repeated electron backscatter diffraction (EBSD) analysis to monitor grain nucleation and growth.

Mechanical properties of materials were investigated in the initial state and heating at 50, 100, and 150 °C using static compression and tensile tests.

The results demonstrated that zinc alloys have greater thermal stability than pure zinc. The presence and distribution of second-phase particles during recrystallisation significantly influence the material. Advanced microstructural characterisation allowed both qualitative and quantitative assessment of the changes in the materials during heating at high temperatures. Microstructural changes were correlated with mechanical properties,

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