Graduate Seminar

The Department of Biomedical Engineering and Materials Science and Engineering

presents

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Development and Characterization of Magnesium-Neodymium Alloys for Biomedical Applications

The aim of the presented study is to investigate and demonstrate the potential of neodymium additions as a substitute for rare earth (RE) mischmetal in magnesium alloys for biomedical applications. Here, the alloys LAE442, LANd442, ZEK100, ZNdK100, and Nd2 were manufactured and processed to evaluate their material characteristics in different states and to investigate the effects of Nd additions. To determine the mechanical characteristics of these alloys, tensile tests were initially carried out in the hot extruded state. Subsequent T5- and T6-heat treatments were conducted to reveal their effect on the alloys' strength and elongation values. The general degradation behavior of the alloys in a 0.9% NaCl solution was investigated by means of polarization curves and hydrogen evolution. In addition, by using various *in-vivo*-parameters, a corrosion environment was established to determine the alloys' degradation *in vitro*. Comparing LAE442 and LANd442, a lack of corrosive stability could be observed while the mechanical strength remained constant in the latter alloy's Nd substitution for the RE mischmetal. A contrary effect was determined for the alloy ZEK100 compared with ZNdK100. In both substitutional approaches, heat treatment procedures could not align the substitutes' material properties with the educts' material properties. However, in the case of Nd2, which was initially chosen as relevant alloy to determine the effects of Nd on Mg in a simple binary composition, excellent ductility and corrosion properties could be observed. This makes the alloy a promising candidate for use as resorbable implant material, especially in the field of stenting applications. Here, the enormous increase of ductility, promoted by an advantageous microstructural behavior under loadings, could be attributed to additions of Nd.

Bio: Within the past 5 years, Dr. Seitz has worked as a PhD Student and Scientist at Leibniz Universität in Hannover, Germany, with a focus on lightweight materials research and biomedical engineering applications. He developed process chains for resorbable Mg-implant applications such as stents, intramedullary nails, and sutures. This work included basic processes such as casting, hot-extrusion, heat treatment, drawing and coating procedures, as well as many analytical processes. The impact of different alloying elements on the mechanical and corrosive behavior of Mg in different conditions was one of the biggest challenges in this context. Besides the development of promising biodegradable Mg alloys, he also worked on the manufacture of thin wires from magnesium by means of extrusion and drawing processes. During an overseas stay at The University of Auckland, he developed polymer and ceramic based coatings for medical applications with magnesium and analyzed their structural behavior in a corrosive environment.

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