Zn–Mg–Sr Alloy Synthesized by Mechanical Alloying and Spark Plasma Sintering for Bio-applications

David Nečas [1], Jiří Kubásek [1], Jan Pinc [1], Ivo Marek [1], Črtomir Donik [2], Irena Paulin[2] and Dalibor Vojtěch [1]

[1] Department of Metals and Corrosion Engineering, Faculty of Chemical Technology, University of Chemistry and Technology, Prague Technická 5, 166 28, Praha 6–Dejvice, Czech Republic
[2] Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Lepi pot 11, Slovenia

E-mail: necasd@vscht.cz

Zinc is recognized as a promising material for biodegradable applications, primarily due to its remarkable biocompatibility and reasonable corrosion rate, which avoids the formation of toxic byproducts and hydrogen release. However, its mechanical properties are often inadequate for many medical applications.

This study focuses on addressing the mechanical limitations of zinc by refining its microstructure, particularly by reducing grain size. To achieve this, we employ a combination of two powder metallurgy techniques: mechanical alloying (MA) and spark plasma sintering (SPS). By utilizing these methods, we prepare a nanograin material with a composition of Zn–1Mg–0.5Sr. Both selected alloying elements to improve the mechanical properties and biocompatibility of zinc alloys.

The compacted material exhibits a microstructure comprising zinc grains and intermetallic phases of Mg_2Zn_{11} and $SrZn_{13}$, ranging in size from 100 to 500 nm. This refined microstructure leads to exceptional mechanical properties, including high hardness (86 HV1) and compressive strength (327 MPa). Notably, the proposed combination of techniques offers an innovative approach to achieving extremely fine microstructures while minimizing significant grain coarsening during powder compaction at elevated temperatures.

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