Institute of Light Metals (ILM) Joint Usage/Research Grant Report in FY 2025

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Principal investigator	Affiliation	Charles University
	Job title	Assistant Professor
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Collaborated researcher of ILM	Affiliation	Institute of Light Metals / Magnesium Research Center
	Job title	Director
	Name	Prof. Yoshihito Kawamura
Title of the joint research	Investigation of high temperature performance of rapidly solidified ribbon-consolidated low-alloyed Mg-Zn-Y/Gd alloy.	
Joint research Program ※check the box	☐ Program for Joint Usage / Research Centers (JURC) **X** Program for International JURC ☐ Program for providing samples and materials ☐ Program for using ILM facilities for sample analysis and characterization	☐ Focused themes ☐ Transportation **X** Biomaterials **X** Bridge/building materials ☐ Kink strengthening ☐ Independent research theme
Name of joint usage apparatus	Material preparation: melting furnace, rapid solidification machine, extruder; Sample preparation: lathe, cutting machines; Basic microstructure analysis (chemical composition and optical microscopy): ICP Emission Spectroscopy SHIMADZU ICPS-8100, Confocal microscope Lasertec OPTELICS HYBRID	
Total amount of grant	Travel expense (230 000 JPY)	Consumable Fee (50 000 JPY)

Research Results

【The major results】 The project was focused on identifying the active deformation mechanisms and evaluating their thermal stability in a low-alloyed Mg-Zn-Y alloy processed by the rapidly solidified ribbon consolidation (RSRC) technique. By combining electron microscopy with in-situ and ex-situ X-ray diffraction (XRD) profile analysis, a comprehensive understanding of the relationship between microstructure, temperature, and mechanical behavior was achieved. The alloy exhibits a bimodal microstructure consisting of ultrafine dynamically recrystallized and coarse non-recrystallized grains, with solute-rich stacking faults (SFs), cluster-arranged layers (CALs), and cluster-arranged nanoprecipitates (CANaPs). This microstructure remains stable during static heat treatment up to 300 °C, showing only minor redistribution of solute-rich layered structures. The material demonstrates excellent mechanical performance at room temperature and 200 °C, with only a slight reduction in yield strength; however, at 300 °C, significant softening occurs. Deformation mechanisms were confirmed to be strongly temperature-dependent. Twinning operates only under compression at lower temperatures, while deformation at elevated temperatures is governed by dislocation slip. Significant increase in dislocation density is observed during deformation at lower temperatures, dominated by non-basal ⟨a⟩ dislocations. Overall, the RSRC low-alloyed Mg-Zn-Y alloy exhibits a unique combination of stable microstructure and excellent mechanical properties at moderate temperatures.

【Future Prospects】 In order to complete the obtained results, the quantitative TEM analysis of solute-rich layered structures (SFs, CALs, CANaPs) is essential to clarify their respective roles in deformation behavior and thermal stability. Further, hot temperature performance of optimized Mg-Zn-Y/Gd alloys with minor additions of elements such as Mn, Ca, or Al (up to 1 at.%) is of high interest for evaluation of potential areas of their application.

【Concrete results】 The obtained results are partly summarized in the manuscript “Hot temperature deformation of high-strength Mg-Zn-based alloys prepared by RSRC technique” for publication in a journal with an impact factor (e.g., JMA, or JALCOM) and will also be presented at the International Symposium on Physics of Materials -ISPMA (September 6-10, 2026, Prague, Czech).

Notes

・Please use the form and submit to the URL provided in the email by Friday, May 15, 2026.
・The joint research report will be published in the ILM joint research report (annual report) and will be available on our website. Therefore, please prepare the contents for public release accordingly.
・Please add pages, if needed.