Institute of Light Metals (ILM) Joint Usage/Research Grant Report in FY 2023

2024/05/22

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| Principal investigator | Affiliation | **Universiti Kebangsaan Malaysia, Malaysia** |
| Job title | **Assistant Professor** |
| Name | Intan Fadhlina Mohamed |
| Collaborated researcher of ILM | Affiliation | MRC, Kumamoto University |
| Job title | Professors |
| Name | Zenji Horita |
| Title of the joint research | **Achieving superplasticity of Mg alloys using process of high pressure sliding** |
| Joint research Program※check the box | □　Program for Joint Usage / Research Centers (JURC)□　Program for International JURC□　Program for providing samples and materials□　Program for using ILM facilities for sample analysis and characterization | □ Focused themes□ Transportation□ Biomaterials□ Bridge/building materials□ Kink strengthening□　Independent research theme |
| Name of joint usage apparatus | **Tensile testing machine, Electro Discharge Machine** |
| Total amount of grant | Travel expense（ 300,000JPY） | Consumable Fee（　　　　　　　　　　JPY） |
| **Research Results**　**※Please describe following three items briefly.**【The major results】**This study utilized a severe plastic deformation (SPD) technique known as incremental feeding high-pressure sliding (IF-HPS), which enables significant grain refinement over an expanded sheet area. This method was applied to magnesium alloys such as AZ31, AZ61 and AZ91. The grain sizes were reduced to the submicrometer range, resulting in tensile strength nearly doubling compared to their annealed states. The IF-HPS process conditions were optimized to maintain high tensile strength while preventing crack initiation in the sheets. The likelihood of crack formation decreased with an increased number of reciprocations and shorter sliding distances. Additionally, process conditions were explored to ensure homogeneous tensile property development throughout the processed sheets. The study demonstrated that the IF-HPS process effectively enlarges the SPD-processed area without requiring increased machine capacity, while still enhancing mechanical properties. The advent of superplasticity where the formation of fine-grained structure is indispensable.**【Future Prospects】**The application of the IF-HPS process was a success in enhancing the mechanical properties of AZ31, AZ61, and AZ91. Although it was shown that the sample size increased to a more practical level with IF-HPS, the surface of the Mg alloy samples peeled to a certain depth during the IF-HPS process. This peeling may potentially alter the actual mechanical properties of the alloy. To reduce the peeling effect of Mg alloys, the optimal conditions will be determined by manipulating the processing parameters such as sliding distance and sliding speed of the IF-HPS process. The effects of sliding distance and speed are studied to optimize the process. The grain refinement will be assessed based on the development of superplasticity, which requires the formation of fine-grained structure.**【Concrete results】**<Publication>****(1) Takahiro Masuda, Yongpeng Tang, Intan Fadhlina Mohamed and Zenji Horita, Mat. Sci.Eng.A 879 (2023) 145240. “Ultrafine-grained AZ61 alloy produced by high-pressure torsion:**  **Advent of superplasticity and effect of anisotropy”****<International Conference>****(1) I. F. Mohamed, Z. Horita and A. Muhammad** **The 11th Pacific Rim International Conference on Advanced Materials and Processing, International** **Convention Centre, Jeju, Korea, November 19-23, 2023.****(2) Z. Horita, I. F. Mohamed** **Centre of Advanced Materials Engineering and Smart Manufacturing Seminar on Severe Plastic Deformation under High-pressure for Functional Properties, Universiti Kebangsaan Malaysia, Malaysia, March 21, 2024.** |
| **Notes**・Please use the form and submit to ILM office (mrc@kumamoto-u.ac.jp) by Friday, April 28, 2023.・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. |