Institute of Light Metals (ILM) Joint Usage/Research Grant Report in FY 2024

2025/MM/DD

|  |  |  |
| --- | --- | --- |
| Principal investigator | Affiliation | Hanoi University of Science and Technology |
| Job title | Associate Professor |
| Name | Pham Mai Khanh |
| Collaborated researcher of ILM | Affiliation | University of Toyama |
| Job title | Associate Professor |
| Name | Seungwon Lee  |
| Title of the joint research | Effect of Cu on precipitation behavior of Al-Mg-Si extrusion alloys |
| 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 themesX□ Transportation□ Biomaterials□ Bridge/building materials□ Kink strengthening□　Independent research theme |
| Name of joint usage apparatus | HRTEM（EM-002B, Topcon, University of Toyama）、STEM（Talos 200X G2, Thermo Fisher Scientific, ARC in University of Toyama） |
| Total amount of grant | Travel expense（ 240,000 JPY） | Consumable Fee（ 60,000 JPY） |
| **Research Results**　**※Please describe following three items briefly.**【The major results】Al-Mg-Si alloys are age-hardened aluminum alloys that are widely used as extrusion materials for building materials, among other applications, due to their high specific strength, excellent formability, and good corrosion resistance due to anodizing. In extrusion materials, strengthening effects due to processing and grain refinement are expected, and even better mechanical properties can be achieved by applying appropriate aging treatment. In this study, we aim to improve the mechanical properties of 6000 series aluminum alloys by controlling their structure and analyzing the formation behavior of precipitates and their effects in detail. Our investigation will focus on the effects of additive elements, aging temperature, aging time, and processing conditions on the morphology and distribution of precipitates. Through microstructural analysis using a transmission electron microscope (TEM), we will elucidate the optimal strengthening mechanism. The objective of this study is to enhance the mechanical properties of 6000 series aluminum alloys through precise control of their structure.【Future Prospects】In recent years, there has been an increased focus on reducing CO₂ emissions due to global environmental concerns. As a result, more stringent regulations are anticipated in Europe by 2030. In response to these strengthened environmental regulations, the automobile industry is promoting fuel efficiency and electrification. As part of this, weight reduction of vehicle bodies has become an important issue. Aluminum alloys offer a high specific strength, making them a popular lightweight material for replacing steel in various applications. Notably, the 6000 series (Al-Mg-Si system) aluminum alloys have proven particularly effective due to their ability to undergo heat treatment for enhanced strength, making them well-suited for use in structural applications within the transportation sector. Our primary objective is to investigate the effect of added elements on the morphology and distribution of precipitates and to clarify the correlation with mechanical properties. The results of this research will contribute to improving the mechanical properties of 6000 series aluminum alloys through microstructural control, and provide fundamental knowledge to expand the range of applications as lightweight structural materials.【Concrete results】* Aluminum alloys

Patent application No. 2009-276586, Kenji Matsuda, Susumu Ikeno, Tsunemasa Kawabata, Hiroyoshi Nishida* Aluminum alloy components with excellent ductility

Patent application No. 2004-185603, Tomoo Yoshida, Kenji Matsuda, Susumu Ikeno* Aluminum alloy material with excellent low-temperature bake hardening and formability

Patent application No. 2004-160460, Kenji Matsuda, Susumu Ikeno, Yoshiyuki Himuro, Katsumi Koyama* Al-Mg-Ge aluminum-based alloys and aluminum alloy materials using them

Patent application No. 2006-133123, Kenji Matsuda, Susumu Ikeno, Tsunemasa Kawabata |
| **Notes**・Please use the form and submit to the URL provided in the email by Friday, May 16, 2025.・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. |