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

2024/05/22

Principal investigator	Affiliation	The Sirindhorn International Thai-German Graduate School of Engineering, King Mongkut's University of Technology North Bangkok, Thailand
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Collaborated researcher of ILM	Affiliation	ARC, University of Toyama
	Job title	Professor
	Name	Tomomi Shiratori
Title of the joint research	In-line tribological observations of textured DLC-Si coatings	
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	Extrusion testing apparatus, Hydraulic press, Sputtering machine, In-line wear depth observation, EPMA, Raman spectroscopy, Laser texturing machine and other facilities	

Total amount of grant	Travel expense (300,000JPY)	Consumable Fee (JPY)

Research Results ※Please describe following three items briefly.

【The major results】 The friction properties of three coatings (AlCrN, TiAlN, and DLC) were investigated using V-groove compression tests. At 500°C, AlCrN coatings had an optimum compression force of 11.65 kN, which was different to TiAlN and DLC at 11.08 and 11.89 kN, respectively. This coating indicated the lowest shear friction of 0.65 at an aspect ratio (H/W) of 0.586 during the forming of the aluminum 7075 series. The observation of TiAlN and DLC-coated dies showed severe smearing and delamination wear, except the AlCrN-coated die. The formed aluminum workpiece had the appearance of surface cracking during production onto TiAlN and DLC-coated dies; however, no cracking was created utilizing the AlCrN-coated dies. The improvement of micro-extrusion processing of a AA6063-T6 workpiece has been successfully received by applying a nano-texture to the surface of the CoCrMo die; this surface treatment method effectively lowered the extrusion force by two times that of non-textured CoCrMo and AISI H13 dies.

【Future Prospects】

Although great results are being achieved for textured die surfaces; however, there is limited research available on optimizing the texturing input parameters on the tribological performance of extrusion dies. While significant progress has been made in minimizing friction and wear through this surface treatment technique, the issue of aluminum transfer onto die surfaces remains a challenge to be tackled for any new coating aimed at preventing galling and tearing during forming processes. Also, the expected results of further research are needed to minimize the friction and wear properties of the die material.

【Concrete results】

<Publication>

(1) T. Funazuka et al., Effect of CoCrMo Die and Tool Surface Nano-Texture on Micro Backward Extrusion Formability of AA6063-T6. J. Micro Nano-Manuf. Jun 2023, 11(2): 021001 (7 pages)

<International Conference>

(1) T. Funazuka et al., Phenomena of tool adhesion at elevated temperature in V-groove friction test of AA7075, International ESAFORM Conference 2023, 19-21 April 2023, Kraków, Poland.

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.